TURCK

Industrial
Automation

IO-LINK MASTER -

User Manual

All brand and product names are trademarks or registered trade marks of the owner concerned.

Edition 11/2008

© Hans Turck GmbH, Muelheim an der Ruhr

All rights reserved, including those of the translation.

No part of this manual may be reproduced in any form (printed, photocopy, microfilm or any other process) or processed, duplicated or distributed by means of electronic systems without written permission of Hans Turck GmbH & Co. KG, Muelheim an der Ruhr.

Subject to alterations without notice

Warning!
Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit.
- Cover or enclose neighboring units that are live.
- Follow the engineering instructions of the device concerned.
- Only suitably qualified personnel in accordance with EN 50 110-1/-2 (VDE 0 105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or to the potential equalization. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC 60 364-4-41 (VDE 0 100 Part 410) or HD 384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60 204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).
- The electrical installation must be carried out in accordance with the relevant regulations (e. g. with regard to cable cross sections, fuses, PE).
- All work relating to transport, installation, commissioning and maintenance must only be carried out by qualified personnel. (IEC 60 364 and HD 384 and national work safety regulations).
- All shrouds and doors must be kept closed during operation.

Table of Contents

About this Manual

Documentation Concept 0-2

Description of Symbols Used 0-3

Overview 0-4

Prescribed Use 0-4
Notes Concerning Planning /Installation of this Product 0-4

1 PROFIBUS-DP

System overview 1-2

Master/Slave system 1-2
System configuration and device types 1-2
Topology 1-3
Maximum system extension 1-3
Transmission rate/Cycle times 1-4
Transmission cables 1-4
Diagnostic functions 1-5
Sync and Freeze Mode 1-6
System performance 1-6
GSD files 1-8

Short Description of PROFIBUS-DPV1 1-9

General 1-9
Acyclic data transfer 1-9
DPV1-functions 1-9
DPM1 versus DPM2 1-9
Addressing the data using acyclic services 1-10

2 IO-Link

IO-Link - the fieldbus-independent communication interface 2-2

General technical information 2-2
Transmission media 2-3
Fieldbus integration 2-4
IO-Link and FDT/DTM 2-4

3 Technical features

Function 3-2

Technical data 3-3

Connection possibilities 3-7

Fieldbus connection 3-7
Supply voltage 3-7
M12-connector for IO-Link 3-7

Address setting **3-8**

Process image **3-9**

Process input data 3-9

Status displays and diagnostic messages **3-10**

Status displays via LEDs 3-10
Diagnostic messages/ status messages via software 3-12

GSD-file **3-15**

Entries in the GSD-file 3-15

Parameterization **3-19**

Parameters of the IOLMM (slot 1, IO-Link master module) 3-19
Parameters of slots 2 to 5, IO-Link device module (IOLDM) 3-21
IO-Link sensors from TURCK 3-22

Description of user data for acyclic services **3-24**

Gateway Application Instance, Slot 0 3-24
Module Application Instance, Slot 1 3-24

4 Connection to a Siemens Step 7 - usage of the TURCK-example program

Introduction **4-2**

Electronic Device Data Sheets (GSD) **4-3**

Application example with Siemens PLC and FB 102 (IO-Link CALL) **4-4**

Application example - prerequisites 4-4
The example project 4-4

5 Acyclic data exchange via PROFIBUS-DP C2-master and TURCK IO-Link DTM

Communication via DTM with C2-master **5-2**

Used hardware 5-2
Used software 5-2
Hardware-configuration C2-master 5-2
Configuration of the CommDTM in PACTware™ 5-4
Configuration of the IO-Link master 5-5

6 Guidelines for electrical installation

General Notes **6-2**

General 6-2
Cable routing 6-2
Lightning protection 6-3
Transmission cables 6-3

Potential relationships **6-4**

Electromagnetic compatibility (EMC) 6-5
Ensuring electromagnetic compatibility 6-5
Grounding of inactive metal components 6-5
PE connection 6-5
Shielding of cables 6-6
Potential compensation 6-7
Switching inductive loads 6-7

7 Index

About this Manual

Documentation Concept **2**

Description of Symbols Used **3**

Overview **4**

Prescribed Use 4
Notes Concerning Planning /Installation of this Product 4

Documentation Concept

This manual contains all information about the TURCK IO-Link master SDPX-IOL4-0001.

The following chapters contain a short IO-Link description, exact information about function and structure of the IO-Link master as well as information concerning the connection to automation devices and the different possibilities of parameterization for the master and the connected IO-Link sensors.

Description of Symbols Used

Warning

This sign can be found next to all notes that indicate a source of hazards. This can refer to danger to personnel or damage to the system (hardware and software) and to the facility.

This sign means for the operator: work with extreme caution.

Attention

This sign can be found next to all notes that indicate a potential hazard.

This can refer to possible danger to personnel and damages to the system (hardware and software) and to the facility.

Note

This sign can be found next to all general notes that supply important information about one or more operating steps.
These specific notes are intended to make operation easier and avoid unnecessary work due to incorrect operation.

Overview

Attention

Please read this section carefully. Safety aspects cannot be left to chance when dealing with electrical equipment.

This manual includes all information necessary for the prescribed use of SDPX-IOL4-0001. It has been specially conceived for personnel with the necessary qualifications.

Prescribed Use

Warning

The devices described in this manual must be used only in applications prescribed in this manual or in the respective technical descriptions, and only with certified components and devices from third party manufacturers.

Appropriate transport, storage, deployment and mounting as well as careful operating and thorough maintenance guarantee the trouble-free and safe operation of these devices.

Notes Concerning Planning /Installation of this Product

Warning

All respective safety measures and accident protection guidelines must be considered carefully and without exception.

1 PROFIBUS-DP

System overview 2

Master/Slave system 2
System configuration and device types 2
– Single-Master systems 3
– Multi-Master systems 3
Topology 3
Maximum system extension 3
– Use of Drop lines 4
Transmission rate/Cycle times 4
Transmission cables 4
– Cable types 5
– Installation guidelines 5
– Checking the PROFIBUS cabling 5
Diagnostic functions 5
Sync and Freeze Mode 6
– Sync Mode 6
– Freeze Mode 6
System performance 6
– Data transfer between DPM1 and the DP slaves 7
– Protective mechanisms 7
– Ident. number 8
GSD files 8

Short Description of PROFIBUS-DPV1 9

General 9
Acyclic data transfer 9
DPV1-functions 9
DPM1 versus DPM2 9
Addressing the data using acyclic services 10

System overview

PROFIBUS is a manufacturer-independent and open fieldbus standard for a wide area of applications in factory and process automation. Manufacturer independence and openness are guaranteed by the international standards EN 50170 and EN 50254. PROFIBUS enables communication of devices of various manufacturers without requiring particular interface adaptations.

PROFIBUS-DP (Decentral Periphery) is designed for data transfer between the control and the input/output level. TURCK BL20 stations support PROFIBUS-DP.

PROFIBUS-DP is the speed-optimized PROFIBUS version, specially designed for communication between automation devices and decentralized peripheral devices. PROFIBUS-DP is suited to replace cost-intensive parallel signal transmission via digital and analogue sensors and actuators.

PROFIBUS-DP is based on DIN 19245, part 1 and part 4. During the course of European fieldbus standardization, PROFIBUS-DP has been integrated into the European fieldbus standard EN 50170.

Master/Slave system

PROFIBUS-DP is a master/slave system, which consists of a master (usually integrated in the PLC) and up to 31 slaves per segment. During operation, the master constantly scans the connected slave stations. Several masters may be connected within a single network; this would then be classified as a multi-master system. In this case they pass on their transmission permission (Token Passing).

PROFIBUS-DP uses a bit transmission layer (Physical Layer) based on the industrially proven RS485 standard.

System configuration and device types

PROFIBUS-DP is suited for both mono-master or multi-master system configuration. Thus a high level of flexibility in system configuration is guaranteed. The network comprises 126 devices max. (master or slaves).

Configurable system parameters include the number of stations, the assignment of the station address to the I/O addresses, data consistence of I/O data, format of diagnostic messages and the bus parameters used. Every PROFIBUS-DP system consists of different types of devices.

One distinguishes between three device types:

- DP master class 1 (DPM1)

This is a central control, which exchanges data in a defined message cycle with the remote stations (slaves). Typical devices are, for instance, programmable logic controllers (PLCs) or PCs.

- DP master class 2 (DPM2)

Devices of this type are engineering, configuration or operating devices. They are used during set-up, maintenance and diagnosis, to configure the connected devices, to evaluate parameters and to scan the device status.

- DP slave

A PROFIBUS-DP slave is a peripheral device (I/Os, drives, transducers), which reads input data and provides output data to the periphery. Of course, there are also devices which provide only input or only output data. The input and output data volume depends on the specific device and may comprise up to 244 bytes input data and 244 bytes output data.

Single-Master systems

With mono-master systems merely a single master on the bus is active during bus operation. The PLC is the central control component. The slaves are coupled decentrally to the PLC via the transmission medium. With this type of system configuration the shortest bus cycle times are achieved.

Multi-Master systems

In multi-master operation there are several masters on the bus. These form independent sub-systems, consisting of one DPM1 each and the associated slaves, or additional configuration and diagnostic devices. The slave input and output data can be read by all DP masters. Writing of outputs is reserved to a single DP master (the assigned DPM1 during configuration). Multi-Master systems achieve an average bus cycle time. In time-critical applications you should monitor the bus cycle time via a connected diagnostic tool.

Topology

PROFIBUS-DP communicates via a shielded 2-wire cable according to the RS485 standard. The network topology accords to a line structure with active bus terminators on both ends.

Maximum system extension

PROFIBUS-DP is suited for connection of a large number of I/O points. Up to 126 addressable bus nodes enable connection of thousands of analogue and digital I/O points within a network.

PROFIBUS-DP allows a maximum of 32 nodes per segment; please note that masters and repeaters always count as nodes. One segment is defined as the bus section between two repeaters. If no repeaters are used, the entire network corresponds to one segment. Segments must comply with the specified maximum length and the specified transmission rates. Up to nine repeaters, type "REP-DP0002" may be connected within a network. The maximum length of a bus line within a segment and the number of repeaters are listed in the following table.

Table 1: Maximum System expansion PROFIBUS-DP

Communication rate	Length of bus line	Max. no. of repeaters	Max. no. of nodes
9.6 kbps	1200 m	2	126
19,2 kbps	1200 m	2	126
93,75 kbps	1200 m	2	126
187,5 kbps	1000 m	2	126
500 kbps	400 m	4	126
1.5 Mbps	200 m	6	126
12 Mbps	100 m	9	126

Attention

The maximum number of 32 bus nodes may not be exceeded without a repeater.

Use of Drop lines

Note

The length of drop lines may not exceed 6.6 m at a transmission speed of 1.5 Mbps. At a transmission speed of 12 Mbps it is not permitted to use drop lines.

Transmission rate/Cycle times

The transmission rate set by the PROFIBUS-DP master determines the system's transmission speed. Depending on the gateway, the transmission speed can be adjusted in a range of 9,6 kbps up to 12 Mbps.

Transmission cables

The bus nodes are interconnected via fieldbus cables, which accord to RS485 specifications and DIN19 245. The cables must thus have the following characteristics:

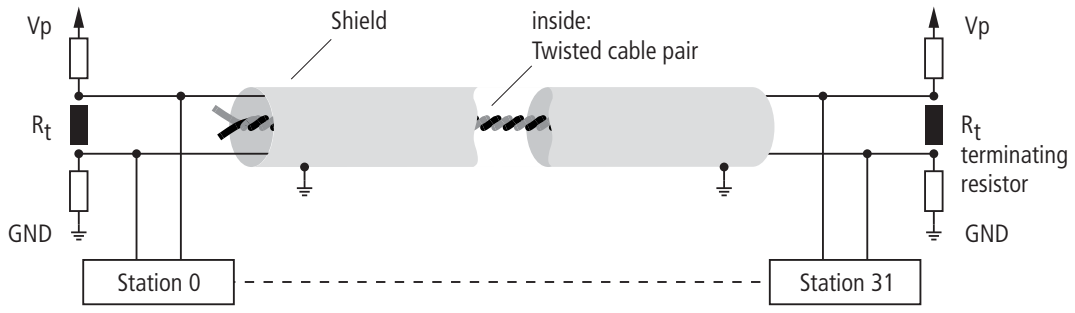
Table 2: Characteristics of PROFIBUS-DP transmission cables

Parameters	Cable type A (DIN 19 245 part 3)
Wave resistance	135 to 165 Ω (3 to 20 MHz)
Capacitance	< 30 pF/km
Loop resistance	< 110 Ω/km
Conductor diameter	> 0.64 mm
Conductor cross section	> 0.34 mm^2
Terminating resistors	220 Ω

Attention

The higher the transmission rate, the higher the number of bus nodes and the longer the transmission cables, the more important to observe these parameters.

Figure 1: Schematic PROFIBUS-DP cables



Cable types

The bus cable of the PROFIBUS-DP network is a special shielded twisted data cable according to RS485 standards. The data transmission rate is 12 Mbps max.

Note

Premoulded PROFIBUS-DP cables simplify network installation, shorten set-up times and reduce wiring errors. TURCK offers an extensive and varied product spectrum for this purpose.

The ordering information on the available cable types can be taken from the respective product catalogue.

Installation guidelines

When mounting the modules and routing the cables please observe the technical guidelines of the PROFIBUS user organization concerning PROFIBUS-DP/FMS (see www.profibus.com).

Checking the PROFIBUS cabling

A PROFIBUS cable (or the cable segment if repeaters are used) can be tested with a few resistance measurements. For this the cable should be disconnected from all stations:

- Resistance between "A" and "B" at the beginning of the cable: approx. 110 Ω
- Resistance between "A" and "B" at the end of the cable: approx. 110 Ω
- Resistance between "A" at the beginning and "A" at the end of the cable: approx. 0 Ω
- Resistance between "B" at the beginning and "B" at the end of the cable: approx. 0 Ω
- Resistance between shield at the beginning and shield at the end of the cable: approx. 0 Ω

If these measurements are successful, then the cable can be used according to standards. However, if there are further disturbances on the bus, electromagnetic interference should be considered as cause. Please also observe the installation guidelines of the PROFIBUS user organization (www.profibus.com)

Diagnostic functions

The comprehensive diagnostic functions of PROFIBUS-DP allow fast error localization.

The PROFIBUS-DP diagnosis is divided into three levels:

Table 3: PROFIBUS-DP diagnosis

Type of diagnosis	Description
station-related diagnostics	Messages concerning the general operational readiness of a bus node.
Module-related diagnostics	These messages indicate that there is a diagnostic message within the a certain I/O area (e.g. 8 bit output module) of a bus node.
Channel-related diagnostics	Here the error cause of a single input/output bit, i.e. relating to a single channel, is indicated. Example: "Short-circuit at output 2"

The PROFIBUS slaves of the BL20 series support the diagnostic functions of PROFIBUS-DP.

The evaluation of the diagnostic data via the control depends on the support of the master.

Note

Further information on diagnostics can be taken from the device descriptions of the master interfaces of the various manufacturers.

Sync and Freeze Mode

In addition to the node-specific user data traffic, which is automatically controlled by the DPM1, the DP master has the possibility to send control commands to a slave, a group of slaves, or simultaneously to all DP slaves. These control commands are transmitted as multi-cast messages.

The Sync and Freeze mode for synchronization of the DP slaves can be determined via the control commands. They enable event-controlled synchronization of the DP slaves.

Sync Mode

The DP slaves initiate the Sync mode upon receipt of a Sync control command from the assigned DP master. In this mode, all addressed DP slaves "freeze" their present output status.
During the following user data transfer cycles, the output data are stored by the DP slaves, while the output states are retained. Only after receipt of the next Sync control command from the master, the stored output data are switched through to the outputs.
The Sync mode is terminated upon an Unsync control command.

Freeze Mode

The Freeze control command induces the addressed DP slaves to assume the Freeze mode. In this mode, the momentary values of the input states are "frozen". Input data will only be updated upon receipt of the next freeze command from the DP master by the affected devices.
The Freeze mode is terminated upon an Unfreeze control command.

System performance

In order to achieve a relatively high level of device interchangeability, the PROFIBUS-DP system performance has also been standardized. It is largely determined by the operating status of the DPM1. This can be either controlled locally or via the bus from the configuration device.

One distinguishes between three major conditions:

Table 4: Operating modes

Operating mode	Description
Stop	There is no data transfer between the DPM1 and the DP slaves. The coupling module merely addresses the modules once after power-up (none of the I/O LEDs illuminate).
Clear	The DPM1 reads the input data of the DP slaves and retains the outputs of the DP slaves in the safe state (depending on the reaction to fieldbus errors, the green I/O LED illuminates and the outputs are set).
Operate	The DPM1 is in the data transfer phase. During cyclic data exchange the inputs of the DP slaves are read and the output information is transferred to the DP slaves (the green I/O LED illuminates).

The DPM1 sends its local status within a configurable time interval via a multi-master command to all assigned DP slaves. The system response to an error in the data transfer phase of the DPM1, e.g. a failure of a DP slave, is determined by the operating parameter "Auto-Clear". If this parameter is set to "True", then the DPM1 switches all outputs of the assigned DP slaves to the safe status, as soon as a DP slave is no longer capable of user data transfer. Then the DPM1 changes to the "Clear" state. If this parameter is set to "False", then the DPM1 will retain its operating condition also in the event of an error and the user can determine the system response.

Data transfer between DPM1 and the DP slaves

Data exchange between the DPM1 and the assigned DP slaves is automatically controlled by the DPM1 in a determined fixed order. During configuration of the bus system, the user assigns the DP slaves to the DPM1. It is also defined which DP slaves are to be included in or excluded from cyclic user data transfer.

Data exchange between DPM1 and the DP slaves can be divided into the phases parameterization, configuration and data transfer.

Prior to including a DP slave in the data transfer phase, the DPM1 checks during the parameterization and configuration phase, whether the programmed required configuration complies with the actual device configuration. This check is used to verify that the device type, the format and length information as well as the number of inputs and outputs accord. The user thus is securely protected against parameterization errors. Additionally to the user data transfer, which is automatically effected by the DPM1, it is also possible to send new parameters to the DP slaves upon request of the user.

Protective mechanisms

In the decentralized periphery it is required to provide the system with highly effective protective functions against faulty parameterization or failure of the transmission devices. PROFIBUS-DP applies certain mechanisms to monitor the DP master and the DP slaves. These can be described as time monitoring functions. The monitoring interval is determined during system configuration.

Table 5: Protective mechanisms

Protective mechanisms	Description
Of the DP master	The DPM1 controls the user data transfer of the slaves via the Data_Control_Timer. Each assigned slaves has a monitoring timer of its own. The timer actuates if no user data are transferred correctly during a certain time interval. In this case the user is informed on this condition. If automatic error response (Auto_Clear = True) is enabled, the DPM1 terminates the "Operate" status, switches the outputs of the assigned slaves into the safe status and returns to the operating status "Clear".
Of the DP slave	The slave carries out response monitoring to detect master or transmission errors. If there is no data exchange during the response monitoring interval with the associated master, the slave automatically switches the outputs into the safe status. In multi-master system operation, an additional access protection is required for the inputs and outputs of the slaves, in order to ensure that only the authorized master has direct access. The slaves provide an input and output image for all other masters so that this map can be read by any master, even without access token.

Ident. number

Each DP slave and each DPM1 must have an individual ident. number. It is needed so that the DP master can identify the connected devices directly without creating significant protocol overhead. The master compares the ident. numbers of the connected DP devices with the ident. numbers registered in the configuration data of the DPM2. User data transfer will only be started, if the right device types with the right station addresses are connected to the bus. This provides additional protection against configuration errors. The manufacturer specific ident. nos. are determined and assigned by the PROFIBUS user organization (PNO). The PNO governs the ident. nos. together with the GSD files.

GSD files

Each PROFIBUS-DP module has a so-called GSD file (German abbr. for device data base file) that comprises detailed information on the module: I/O data volume, transmission rates, revision status etc. This GSD file is needed to configure the station within the PROFIBUS-DP system.

The GSD files can be downloaded via the TURCK website under www.turck.com.

Short Description of PROFIBUS-DPV1

General

PROFIBUS-DPV1 is an enhancement of PROFIBUS-DP which provides the possibility of acyclic data communication.

A cyclic and centrally directed data transfer between master and slaves is characteristic for the standard functions of PROFIBUS-DP. A Class1 master (PLC) controls the cyclic exchange of process data with the slaves. The data exchange is carried out in rotation and in a defined order. The data which have to be transmitted are projected beforehand.

Via acyclic communication functions, PROFIBUS-DPV1 now offers the possibility to transmit data to the slave in addition to the cyclic process data.

Acyclic data transfer

The need for acyclic data transfer exists wherever slave devices which provide several parameterization options have to be parameterized during operation.

Typical examples are the parameters of a drive, like limit values, rotational speed or torque, operation mode and the generation of an error list.

Acyclic services are handled with low priority, parallelly and additionally to the cyclic process data transfer. The negative influence on the speed of the high-priority process data transfer, shall thus be minimized.

DPV1-functions

The DPV1-functions consist basically of the services "Read" and "Write". The master uses these services for read- or write access to data blocks in PROFIBUS.

In addition to that, an "intiate" and "abort"-service for the connection management, a "data-transport"-service for the exchange of large data packages and the "alarm"-and "status"-services for the transmission of alarm messages have been defined.

Note

At present, the BLxx-gateways for DPV1 only support the services "Read" and "Write".

DPM1 versus DPM2

PROFIBUS-DPV1 differentiates between two master classes.

An automation system (PLC), which generally controls the basic cyclic process data transfer with standard DP-functions, is defined as Class1-master. A Class1-master can use DPV1-functions optionally.

The new Class2-master is generally an engineering tool which is used for the acyclic data transfer.

The protocol cycle of the DPV1-functions on the fieldbus depends on the use of a Class1- or a Class2-master.

Addressing the data using acyclic services

The data-addressing is done per module by means of the following details:

- slot
- index
- length

The slot-number addresses the module and the index addresses the module's parameters. Each data block can have a maximum size of 240 bytes.

In case of a successful data access, the slave sends a positive answer. If the data access failed, a negative answer which classifies the problem precisely is sent.

2 IO-Link

IO-Link - the fieldbus-independent communication interface 2

General technical information 2
Transmission media 3
Fieldbus integration 4
IO-Link and FDT/DTM 4

IO-Link - the fieldbus-independent communication interface

IO-Link is a fieldbus-independent communication interface for sensors and actuators.

It is based on the IO-Link specification "IO-Link Communication Specification" (Version 1.0 November 2007) of the PROFIBUS Nutzerorganisation e.V..

IO-Link is a point-to-point connection between the sensor/ actuator and an interface module. Up to now, the binary connection was only designed for transferring switching information, but IO-Link now allows 2 bytes to be transferred normally in a 2.3 ms cycle via a combined switching status and data channel.

Other information can be exchanged in addition to the process values, such as parameters or diagnostics messages.

This enables communication with sensors and actuators down to the "last meter" to be established for universal communication

General technical information

- standard I/O-connection technologies in point-to-point connection, unshielded, 20 m wire length
- cylcic process data transfer in typ. 2.3 ms
- paralel service data exchange without any impact on the process data
- communication via 24 V-pulse modulation, standard UART protocoll
- communication between master and device in 3 different transmission speeds
  - 4.800 Baud (COM 1)
  - 38.400 Baud (COM 2)
  - 230.400 Baud (COM 3)

Transmission media

IO-Link does not require any special wiring. The sensors and actuators can continue to be connected using the proven, attractively priced and unshielded industrial cables.

The operating modes available for selection are the standard switch mode and the communication mode.

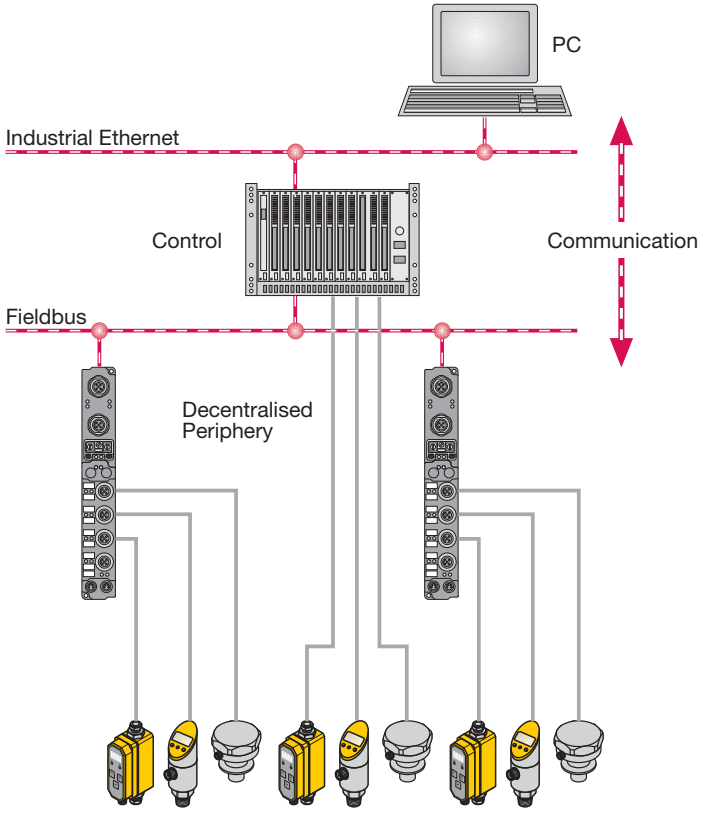
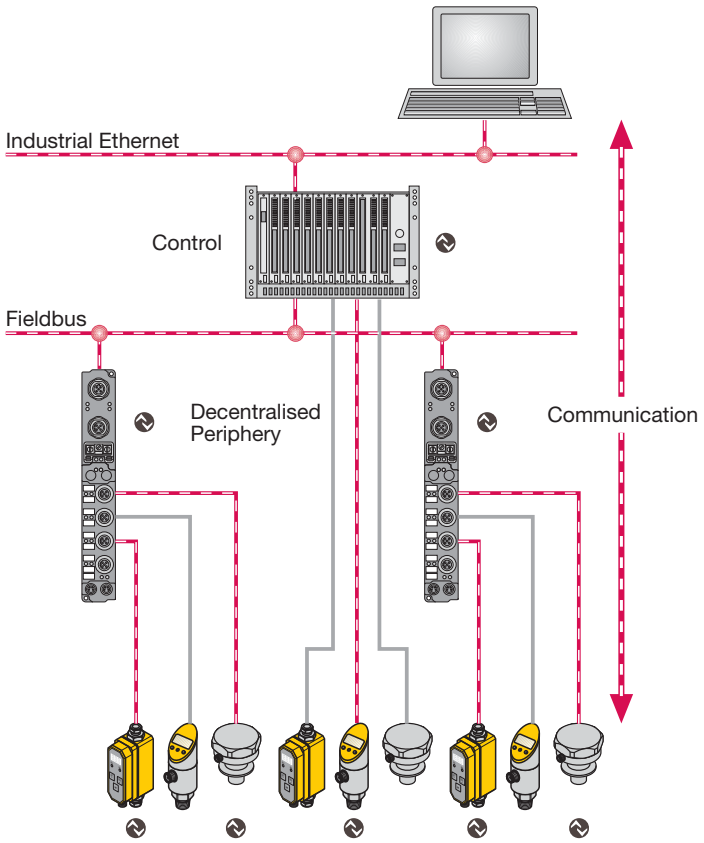


Figure 2: Communication without IO-Link

Figure 3: Communication with IO-Link



Fieldbus integration

- usage of the standard-transport mechanisms of established fieldbusses/ sensor / actuator busses (DPV0, DPV1, …)
- simple integration in engineering systems by means of configuration files (GSD, GSDML, …)
- comfortable usage of even complex product features by means of tool based engineering (FDT/DTM, …)

IO-Link and FDT/DTM

FDT enables a fieldbus and system independent engineering environment to be set up. Generic DTMs allow any type of sensor and actuator to be integrated easily in the system.

3 Technical features

Function **2**

Technical data **3**

– Approvals and tests 6

Connection possibilities **7**

Fieldbus connection 7
– PROFIBUS-DP connection 7
Supply voltage 7
M12-connector for IO-Link 7

Address setting **8**

Process image **9**

Process input data 9

Status displays and diagnostic messages **10**

Status displays via LEDs 10
Diagnostic messages/ status messages via software 12
– Structure of the diagnosis telegram 12
– IO-Link events 14
– Error codes acc. to PROFIBUS-DPV1 1 4

GSD-file **15**

Entries in the GSD-file 15
– Configuration in IO-Link mode 17
– Configuration in SIO-mode 18

Parameterization **19**

Parameters of the IOLMM (slot 1, IO-Link master module) 19
Parameters of slots 2 to 5, IO-Link device module (IOLDM) 21
– Generic IO-Link devices 21
IO-Link sensors from TURCK 22

Description of user data for acyclic services **24**

Gateway Application Instance, Slot 0 24
Module Application Instance, Slot 1 24

Function

The TURCK IO-Link master SDPX-IOL4-0001 is a modular PROFIBUS-DPV1 slave for the connection of a maximum number of 4 IO-Link sensors (TURCK or 3rd party manufacturer) based on physic 2 (3-wire-technology).

The SDPX-IOL4-0001 is both at the same time, PROFIBUS DPV1 slave and IO-Link master. The four C/Q channels (PIN 4) can be parameterized independently and operated in either the IO-Link mode (IOL) or the standard IO mode (SIO).

In the PLC's Hardware Configuration the SDPX-IOL4-0001 is treated as a modular slave with 5 modules. Slot 1 represents the IO-Link master module (IOLMM), slots 2 to 5 the IO-Link devices.

The parameterization can optionally be done via GSD (per DP Master Class 1) or via FDT/DTM (per DP Master Class 2), see Chapter 4.

Besides the described IO-Link functionality, the module offers additionally 4 digital pnp-inputs at PIN 2 of every single M12-female connector.

Technical data

Figure 4: SDPX-IOL4-0001

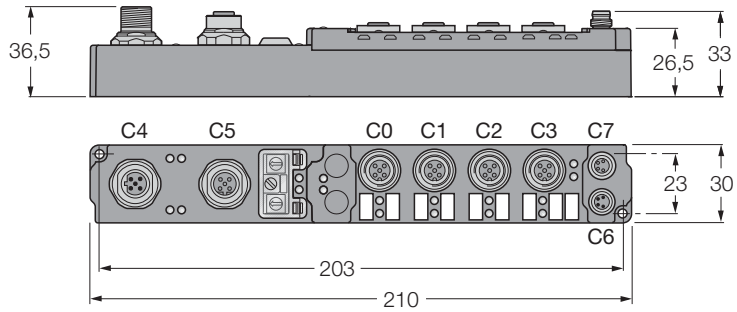


Table 6: Technical data

Power supply	
U_B nominal value (range)	24 V DC (21,6 to 28,4 VDC)
I_B	max. 200 mA
U_L	24 V DC (21,6 to 28,4 VDC) Not required, only monitored for an eventual transmission.
Physical interfaces	
– Fieldbus	
PROFIBUS-DP	9.6 kBit/s to 12 MBit/s potential isolation between fieldbus and operating voltage
Addressing fieldbus	1 - 100 via dec. rotary coding switches (00 = addr. 100)
Fieldbus connection technology	2 × M12
Fieldbus shield connection	via PROFIBUS-DP cable
– Inputs	Pin 4 in SIO-mode and Pin 2
Number of channels	4 (8) digital pnp inputs (EN 61131-2)
Input voltage	21.6 ... 28.4 VDC from operating voltage
Signal voltage low level	-3 to 5 VDC (EN 61131-2, type 2)
Singal voltage high level	11 to 30 VDC (EN 61131-2, type 2)
Max. input current	6 mA
– Inputs (IO-Link mode)	Pin 4
Parameterization: support of IO-Link specification V1.0	GSD, function block and FDT/DTM
Synchronization	port spanning synchronization possible
Diagnostics	mapping of the IO-Link-diagnostics into the DP-diagnostics

Supported devices	max. 32 byte input / 32 byte output
Frame type	supports all specified frame types
Transmission rate	4.8 kBaud (COM 1) / 38.4 kBaud (COM 2)
Transmission physics	corresponds to 3-wire physics (PHY2)
Communication modes	SDPU via function block and FDT/DTM
Communication	supports IO-Link specification V1.0
Supply of sensor	
R_{ON} (Input resistance (burden))	190 mΩ
I_A (output current)	0.5 A
I_{AMAX}	0.6 A, acc. to IEC 6 11 31-2
Isolation voltages	
U_{TDP} (PROFIBUS/ power supply)	1000 V DC
U_{TIOLDP} (PROFIBUS/ IO-Link-port)	1000 V DC
U_{TIIOL} (IO-Link-Port/ IO-Link-port)	0 V DC
U_{TIOL} (IO-Link-Port/ power supply)	0 V DC
Ambient temperature	
$t_{Ambient}$	0 to +55 °C
t_{Store}	- 25 to + 70 °C
relative humidity acc. to EN 61131-2/EN 50178	5 to 95 % (indoor), no condensation (at 45 °C storage temperature, no functional tests)
Climatic tests	acc. to IEC 61131-2
Noxious gas	– SO^2: 10 ppm (rel. humidity < 75 %, no condensation) – H_2S: 1,0 ppm (rel. humidity < 75 %, no condensation)
Vibration resistance	
10 to 57 Hz, constant amplitude 0,075 mm, 1 g	yes
57 to 150 Hz, constant acceleration 1 g	yes
Vibration mode	frequency cycles with a change rate of 1 octave/min
Vibration duration	20 frequency cycles per coordinate axis
Shock resistance acc. to IEC 68-2-27	18 shocks, semi-sinusoidal 15 g threshold/11 ms, each in ±-direction per space coordinate
Repetitive shock resistance acc. to IEC 68-2-29,	1000 shocks, semi-sinusoidal 25 g threshold/ 6 ms, each in ±-direction per space coordinate

Drop and topple	
Drop height (weight < 10 kg)	1.0 m
Drop height (weight 10 to 40 kg)	0.5 m
Test cycles	7
Device with packaging, electrically tested printed-circuit board	
Electromagnetic compatibility (EMC) according to EN 50 082-2 (Industry)	
Static electricity according to EN 61 000-4-2	
– Discharge through air (direct)	8 kV
– Relay discharge (indirect)	4 kV
Electromagnetic HF fields according to EN 61 000-4-3 and ENV 50 204	10 V/m
Conducted interferences induced by HF fields according to EN 61 000-4-6	10 V
Fast transients (Burst) according to EN 61 000-4-4	
Emitted interference according to EN 50 081-2 (Industry)	acc. to EN 55011 class A, group 1
Material	PA6 (Polyamid), encapsulation compound: Polyurethane
Mounting	2 x through-holes Ø 3 mm
Contacts	CuZn, gold-plated

Warning

This device can cause radio disturbances in residential areas and in small industrial areas (residential, business and trading). In this case, the operator can be required to take appropriate measures to suppress the disturbance at his own cost.

Approvals and tests

Table 7: Approvals and tests

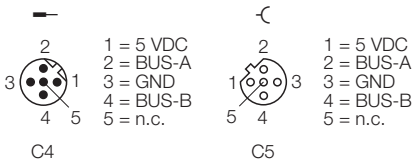
Designation	
Approvals	
CE C-UL U.S.	
Tests (EN 61131-2)	
Cold	DIN IEC 68-2-1, temperature - 25 °C / -13 °F, duration 96 h; not in use
Dry heat	DIN IEC 68-2-2, Temperature +85 °C / 185 °F, duration 96 h; device not in use
Damp heat, cyclic	DIN IEC 68-2-30, temperature +55 °C / 131 °F, duration 2 cycles every 12 h; device in use
Pollution severity according to IEC 664 (EN 61 131-2)	2
Protection class according to IEC 529	IP67

Fieldbus connection

PROFIBUS-DP connection

At the SDPX-IOL4-0001, the connection to PROFIBUS-DP is realized via two M12-connectors.

Figure 5: M12-connector for PROFIBUS-connection



Supply voltage

The connection of the supply voltage is done via 4-pole M8-connectors at each module.

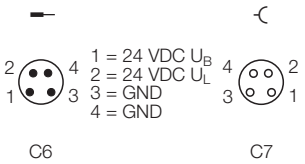
- operating voltage U_B

The 24 VDC operation voltage U_B is used to supply the fieldbus (termination), the processor logic, the IO-Link ports as well as the sensors.
The operation voltage is galvanically isolated from the fieldbus (ASIC).

- load voltage U_L

The load voltage U_L is not used in the module but only monitored and provided for eventual transmission.

Figure 6: Pin assignment M8-male and M8-female connector



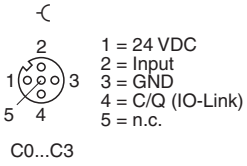
M12-connector for IO-Link

The connection of a maximum number of 4 IO-Link sensors is done via PIN 4 of each of the 4 M12-female connectors on the SPDX-IOL4-0001.

PIN 2 of each female connector can be used to connect simple pnp-inputs.

In case of more complex sensors, PIN 2 can for example be used as an input for a sensor switching point.

Figure 7: Pin assignment of the M12-female connectors

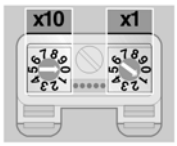


Address setting

At the IO-Link master, the addressing on PROFIBUS-DP is done via 2 decimal rotary coding switches.

A maximum of 99 addresses (01 to 100) can be allocated, whereas switch position 01 corresponds to address "1" and switch position 00 to address "100".

Figure 8: Rotary coding switches for address setting



01 = addr. 1
00 = addr. 100

Each address may be allocated only once in the entire bus structure.

Attention

The cover of the decimal rotary coding-switches must be closed by tightening the screw after use. The seal in the cover must not be damaged or slipped. The protection class IP67 can only be guaranteed when the cover is closed correctly.

Process image

The module SDPX-IOL4-0001 sends 2 byte process input data. It has no process output data.

Process input data

Byte	Bit	Name	Default	Description
0	0	DI channel 0 (port 1)	0	status PIN 4 of port 1, if in SIO-mode
	1	DI channel 1 (port 1)	0	status PIN 2 of port 1
	2	DI channel 2 (port 2)	0	status PIN 4 of port 2, if in SIO-mode
	3	DI channel 3 (port 2)	0	status PIN 2 of port 2
	4	DI channel 4 (port 3)	0	status PIN 4 of port 3, if in SIO-mode
	5	DI channel 5 (port 3)	0	status PIN 2 of port 3
	6	DI channel 6 (port 4)	0	status PIN 4 of port 4, if in SIO-mode
	7	DI channel 7 (port 4)	0	status PIN 2 of port 4
1	0	PD valid channel 0 (port 1)	0	process data (PD) valid at "1"
	1	PD valid channel 1 (port 1)	0	process data (PD) valid at "1"
	2	PD valid channel 2 (port 2)	0	process data (PD) valid at "1"
	3	PD valid channel 3 (port 2)	0	process data (PD) valid at "1"
	4	PD valid channel 4 (port 3)	0	process data (PD) valid at "1"
	5	PD valid channel 5 (port 3)	0	process data (PD) valid at "1"
	6	PD valid channel 6 (port 4)	0	process data (PD) valid at "1"
	7	PD valid channel 7 (port 4)	0	process data (PD) valid at "1"

Status displays and diagnostic messages

Status displays via LEDs

The module provides the following LEDs for status display:

- **PROFIBUS-DP** (not labled, beneath the cover for the address switches):
  2 LEDs (left RED, right GREEN) for status monitoring of the PROFIBUS-communication.
- **RUN** and **ERR**:
  Display of the operating state and hard- or firmware errors.
- **U_B** and **U_L**:
  Monitoring of operation and load voltage.
- Channel LEDs
  - **0**, **2**, **4**, **6**: status display for the IO-Link ports (PIN 4 of the M12-connectors)
  - **1**, **3**, **5**, **7**: status display for the digital inputs (PIN 2 of the M12-connectors)

Table 8: LEDs description

LED	Status	Meaning	Remedy
DP (2 LEDs)	*Green*, ON *Red*, OFF	Device is in Data Exchange	
	Green, ON *Red*, ON	Baud rate has been detected, device is waiting for parameters (WAIT_PRM) or for a configuration (WAIT_CFG).	– False parameterization and/ or configuration of the device – The device possibly has to be configured in the hardware-configuration, first.
	Green, 4 Hz *Red*, 4 Hz	Hardware-error: no control of any other LED	– The device has to be changed. Please contact your TURCK contact person.
	Green, OFF *Red*, ON	No PROFIBUS found, no baud rate detected	– Check the physical properties of PROFIBUS (connection, terminating resistance etc.)
ERR	*OFF*	No extended diagnostics active	-
	Red, *flashing* 0,5 Hz	Extended diagnostics active	– Flashes in case of a channel error together with the respective channel LEDs
	Red, *flashing*, 4 Hz	Hardware error	– The device has to be changed. Please contact your TURCK contact person.

Table 8: LEDs description

LED	Status	Meaning	Remedy
RUN	*ON*	Device in Operational State	-
	OFF	Firmware error	– The watchdog function of the device initializes a reset (undefined flashing possible) – If the error remains, the device has to be changed. Please contact your TURCK contact person.
U_B	*ON*	Operating voltage ok	-
	OFF	Operating voltage below defined tolerances	– Check the voltage supply at the device or at the used power supply unit
	4 Hz	Operating voltage above defined tolerances	
U_L	*ON*	Load voltage ok	-
	OFF	Load voltage below defined tolerances	– U_L is not used in the device. It is only provided for an eventual transmission. – Check the voltage supply at the device or at the used power supply unit
	4 Hz	Load voltage above defined tolerances	
LEDs **0**, **2**, **4**, **6**	*OFF*	Port in *SIO*-mode, but no input signal at PIN 4	-
	Green	*IO-Link*-mode, no error	-
	Green, *flashing,* 0,5 Hz and **ERR** *Red*, *flashing* 0,5 Hz	Diagnostic message at port: Port in *SIO*-mode: – no power supply or overcurrent at port Port in *IO-Link* mode: – no power supply or overcurrent at port – wire break, parameter error or error at the connected device	
	Yellow	Port in *SIO*-mode: active input signal at PIN 4	
LEDs **1**, **3**, **5**, **7**	OFF	PIN 2: no input signal	
	Yellow	PIN 2: active input signal	

Diagnostic messages/ status messages via software

The diagnosis telegram of the IO-Link master SDPX-IOL4-0001 contains the following types of diagnostic messages:

Table 9: Diagnostics for the SDPX

	Length	Remark
DP standard diagnosis	5 byte	
Channel specific diagnosis	3 byte	Standard PROFIBUS-DP error-codes (see Table 10:) **Per channel**, which sends diagnostics. If multiple channels send a channel specific diagnostic messages, for each channel 3 bytes are sent successively.
Device specific diagnosis, IOLMM-diagnosis	5 byte	Diagnostics which affect the whole module (undervoltage, overvoltage), but which are displayed at the IOLMM (slot 1).
Device specific diagnosis, event-diagnosis, see also ”IO-Link events“	8 byte	Event messages from the IO-Link devices at ports 1 to 4. **Per channel.** If multiple devices send device specific diagnostic messages, 8 byte are send for each IO-Link device successively.

Structure of the diagnosis telegram

Standard-diagnosis	**DP standard diagnosis**			
	Byte 0			
	...			
	Byte 5			
Extended diagnostics	**Channel specific diagnosis**			
	Byte 0	Header	0×80	
	Byte 1	Channel	0xC0 + IO-Link-port	Number of the IO-Link channel which sends the diagnostic message
	Byte 2	Type	DP error code	(see Table 10:)
	Device specific diagnosis, IOLMM-diagnosis			
	Byte 0	Header	0×05	Length of the diagnostic message
	Byte 1	Type	0×A0	Manufacturer specific
	Byte 2	Slot	0x01	Slot of the IO-Link master module (IOLMM)
	Byte 3	Specifier	0×00	
	Byte 4	Data_byte0	diagnostic message	Bit 0: UB_TOO_LOW Bit 1: UB_TOO_HIGH Bit 2: UL_TOO_LOW Bit 3: UL_TOO_HIGH Bit 4...7: reserved
	Device specific diagnosis, event-diagnosis			
	Byte 0	Header	0x08	Length
	Byte 1	Type	0x81	Status message
	Byte 2	Slot	0x01	Slot of the IO-Link master module (IOLMM)
	Byte 3	Specifier	0×00	
	Byte 4	Data_byte0	IOL_EventQualifier	Events acc. to IO-Link specification (see “IO-Link events“)
	Byte 5	Data_byte1	IOL_ChannelNumber	
	Byte 6	Data_byte2	IOL_EventCodeLow	
	Byte 7	Data_byte3	IOL_EventCodeHigh	

IO-Link events

Note

The TURCK IO-Link master interprets IO-Link event-diagnostics sent by the device and displays them as plaintext-diagnostic message in the PLC-software.

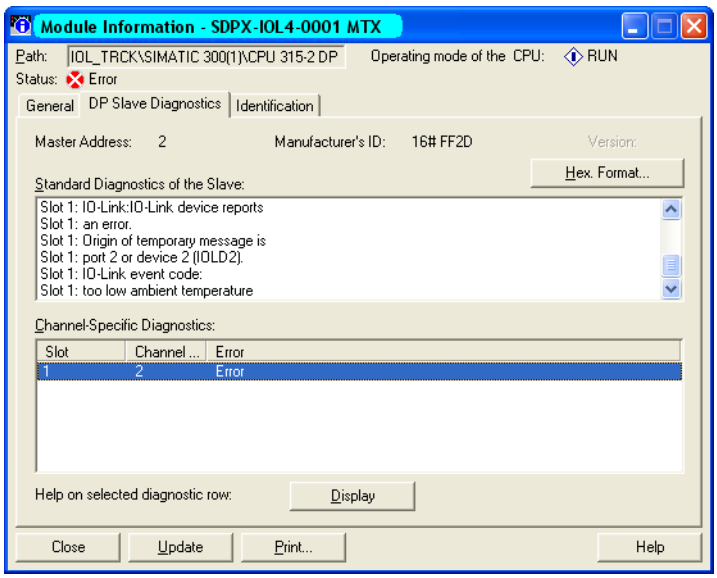


Figure 9: Example for the interpretation of IO-Link events

Error codes acc. to PROFIBUS-DPV1

The following channel-specific error codes acc. to PROFIBUS-DP are generated by the IO-Link master SDPX-IOL4-0001:

Table 10: Error codes acc. to DP

Value (dec.)	Diagnosis	Meaning in IO-Link
Error-Codes (1 to 9 acc. to Norm)		
2	undervoltage	Undervoltage at the sensor
4	overload	Overload at the output
5	overtemperature	
6	wire-break	– Port-configuration of the master does not and connected IO-Link device do not match – Identification (manufacturer-, device-ID) of the IO-Link device failed – no IO-Link device connected
7	upper limit value exceeded	
8	lower limit value exceeded	
9	error	

GSD-file

The actual GSD-file for the IO-Link master SDPX-IOL4-0001 "GSD xxxx.gsd" can be downloaded from our homepage www.turck.com.

By means of the GSD-file, the TURCK-IO-Link sensors can be integrated directly into the system and can be parameterized via GSD. Unknown sensors e.g. from third-party-manufacturers are integrated as generic IO-Link devices.

Note

Chapter 4 contains more detailed information about the configuration of the IO-Link master and the connected sensors in a Siemens PLC.

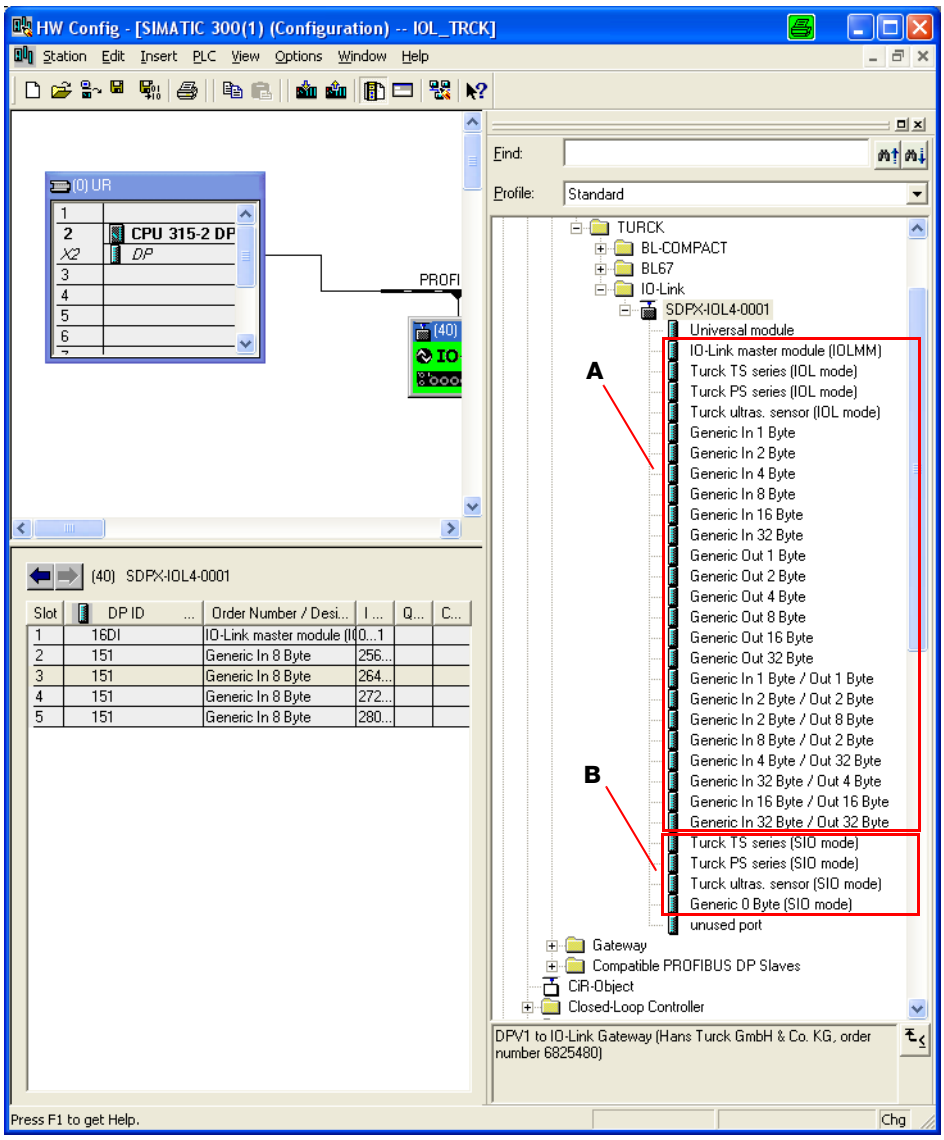
Entries in the GSD-file

The GSD-file shows the IO-Link master as a modular slave with a maximum number of 5 modules, whereas module/ slot 1 is always the IO-Link master (IOLMM = IO-Link master module).

Slots 2 to 5 can be configured freely and can be either used as IO-Link ports (IOL) for the connection of IO-Link sensors or as standard IO-port (SIO) for the connection of simple digital sensors.

Figure 10: IO-Link- master in the GSD-file

A *entries for IO-Link-devices*
B *entries for the usage of ports in SIO-mode*


HW Config - [SIMATIC 300(1) (Configuration) -- IOL_TRCK]
Station Edit Insert PLC View Options Window Help
(0) UR
CPU 315-2 DP
DP
PROFI
(40)
IO
(40) SDPX-IOL4-0001
Slot DP ID Order Number / Desi... I ... Q... C...
1 16DI IO-Link master module (I 0...1
2 151 Generic In 8 Byte 256...
3 151 Generic In 8 Byte 264...
4 151 Generic In 8 Byte 272...
5 151 Generic In 8 Byte 280...
Find:
Profile: Standard
TURCK
BL-COMPACT
BL67
IO-Link
SDPX-IOL4-0001
Universal module
IO-Link master module (IOLMM)
Turck TS series (IOL mode)
Turck PS series (IOL mode)
Turck ultras. sensor (IOL mode)
Generic In 1 Byte
Generic In 2 Byte
Generic In 4 Byte
Generic In 8 Byte
Generic In 16 Byte
Generic In 32 Byte
Generic Out 1 Byte
Generic Out 2 Byte
Generic Out 4 Byte
Generic Out 8 Byte
Generic Out 16 Byte
Generic Out 32 Byte
Generic In 1 Byte / Out 1 Byte
Generic In 2 Byte / Out 2 Byte
Generic In 2 Byte / Out 8 Byte
Generic In 8 Byte / Out 2 Byte
Generic In 4 Byte / Out 32 Byte
Generic In 32 Byte / Out 4 Byte
Generic In 16 Byte / Out 16 Byte
Generic In 32 Byte / Out 32 Byte
Turck TS series (SIO mode)
Turck PS series (SIO mode)
Turck ultras. sensor (SIO mode)
Generic 0 Byte (SIO mode)
unused port
Gateway
Compatible PROFIBUS DP Slaves
CiR-Object
Closed-Loop Controller
DPV1 to IO-Link Gateway (Hans Turck GmbH & Co. KG, order number 6825480)
A
B
Press F1 to get Help.
Chg

Configuration in IO-Link mode

IO-Link sensors from TURCK are defined as individual entries in the GSD-file and can thus be directly selected for the ports as sensors in IO-Link mode.

Devices of third-party-manufacturers have to be configured as generic sensors (Generic In x byte/ Generic Out x byte) according to their process data width. The entry to be selected from the GSD-file has to be ≥ the exact process data width of the device used.

Note

Please find any information about the process data width for devices from third-party-manufacturers in the documentation included.

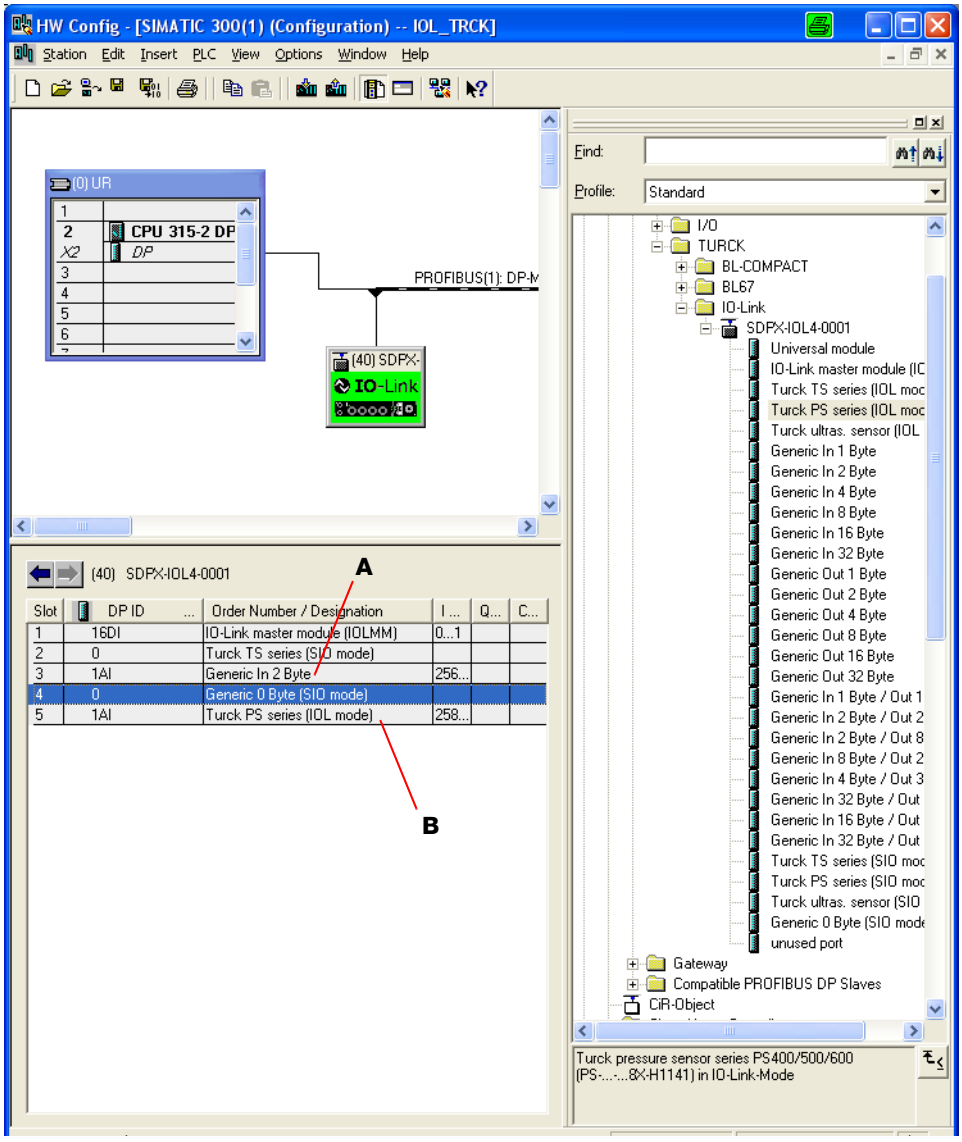


Figure 11: Example configuration with sensors in IO-Link mode

A *third-party-sensor as generic sensor in IO-Link mode*

B *TURCK-sensor in IO-Link mode*

Configuration in SIO-mode

If a TURCK-sensor is to be used in SIO-mode, it has also to be configured in SIO-mode (see blow). The GSD-file also contains entries for the usage of TURCK-sensors in SIO-mode which means, they can thus be directly selected for the ports as well.

In SIO-mode, devices of third-party-manufacturers have to be configured as generic sensors as well, whereas the port has to be configured as "generic 0 byte (SIO-mode)".

Note

If the sensors at slots 2 to 5 are operated in SIO-mode, their user data are mapped into byte 0 (PIN 4) of the IO-Link master (see section ”Process image”, page 3-9).

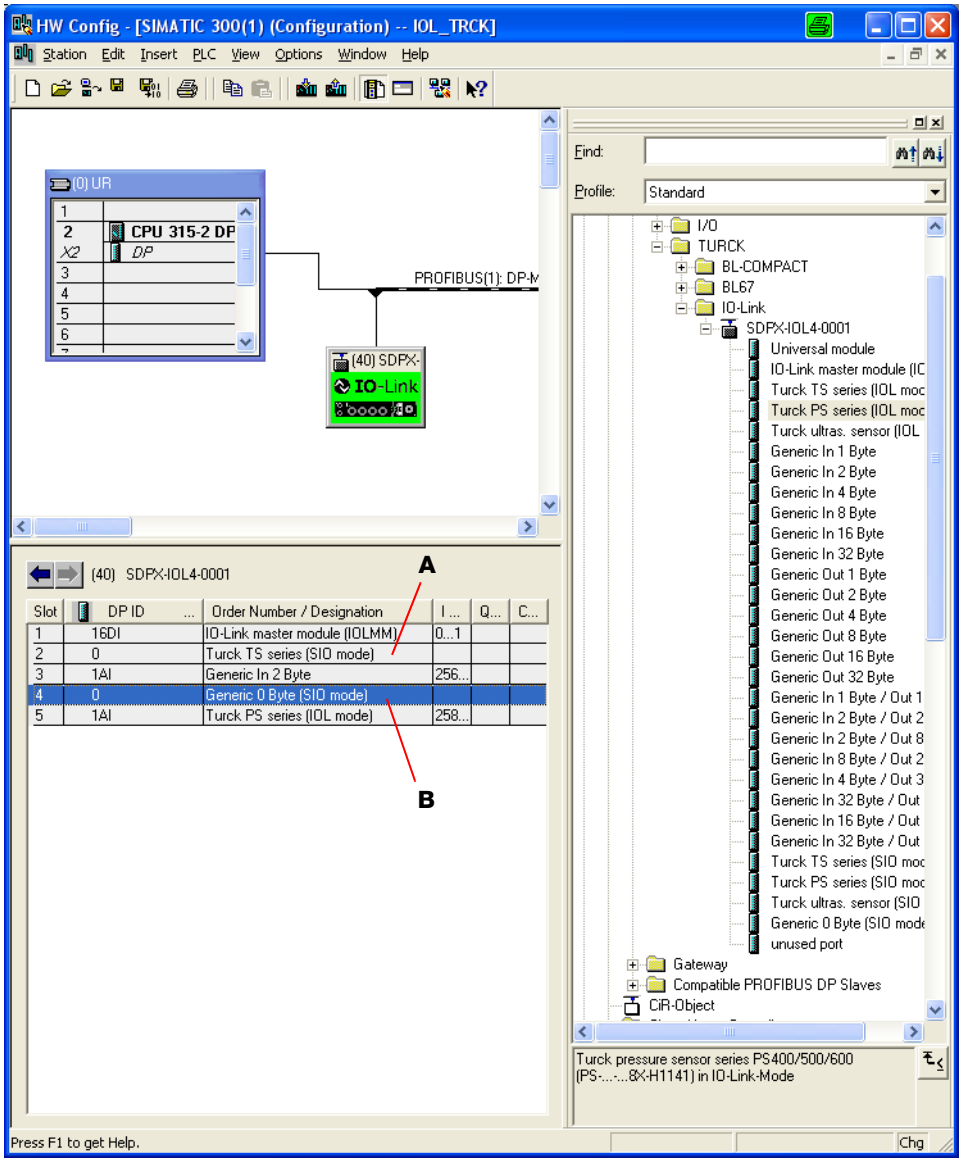

HW Config - [SIMATIC 300(1) (Configuration) -- IOL_TRCK]
Station Edit Insert PLC View Options Window Help
(0) UR
CPU 315-2 DP
DP
PROFIBUS(1): DP-M
(40) SDPX-
IO-Link
Find:
Profile:
Standard
I/O
TURCK
BL-COMPACT
BL67
IO-Link
SDPX-IOL4-0001
Universal module
Turck TS series (IOL moc
Turck PS series (IOL moc
Turck ultras. sensor (IOL
Generic In 1 Byte
Generic In 2 Byte
Generic In 4 Byte
Generic In 8 Byte
Generic In 16 Byte
Generic In 32 Byte
Generic Out 1 Byte
Generic Out 2 Byte
Generic Out 4 Byte
Generic Out 8 Byte
Generic Out 16 Byte
Generic Out 32 Byte
Generic In 1 Byte / Out 1
Generic In 2 Byte / Out 2
Generic In 2 Byte / Out 8
Generic In 8 Byte / Out 2
Generic In 4 Byte / Out 3
Generic In 32 Byte / Out
Generic In 16 Byte / Out
Generic In 32 Byte / Out
Turck TS series (SIO moc
Turck PS series (SIO moc
Turck ultras. sensor (SIO
Generic 0 Byte (SIO mode
unused port
Gateway
Compatible PROFIBUS DP Slaves
CiR-Object
Turck pressure sensor series PS400/500/600
(PS-...-...8X-H1141) in IO-Link-Mode
(40) SDPX-IOL4-0001
Slot DP ID ... Order Number / Designation I ... Q... C...
1 16DI IO-Link master module (IOLMM) 0...1
2 0 Turck TS series (SIO mode)
3 1AI Generic In 2 Byte 256...
4 0 Generic 0 Byte (SIO mode)
5 1AI Turck PS series (IOL mode) 258...
A
B
Press F1 to get Help.
Chg

Figure 12: Example configuration with sensors in SIO-mode

A *TURCK-sensor in SIO-mode*
B *Third-party-sensor as generic sensor in SIO-mode*

Parameterization

In the configuration software, the IO-Link master is shown as modular slave with a IO-Link master module (IOLMM) at Slot 1 and four IO-Link devices at slot 2 to slot 5.

Depending on the connected sensor and on the desired function of the slot, the IO-Link devices are either defined as special TURCK IO-Link sensor (e.g. pressure sensor from the PS-series), as generic IO-Link devices (e.g. sensors from third-party manufactuers) or as SIO (Standard Input/Output).

Parameters of the IOLMM (slot 1, IO-Link master module)

Note

The parameters of the IO-Link master module (slot 1) control the communication of the entire SDPX-IOL4-0001 including all connected sensors.

The texts in the columns "Parameter name" and "Value/ Meaning" correspond to those determined in the GSD-file.

Table 11: Parameters of the IOLMM (slot 1)

A *default-settings*

Parameter name	Value/ Meaning
GSD parametrization	0 = inactive **A** The IO-Link master will not accept a parameterization via GSD-file. Only parameterization via Class 2-master will be accepted.
	1 = active The parameterization of the IO-Link master and the connected sensors is done by the PLC (Class 1-master). Any possible parameterization via Class 2-master will be overwritten by the Class 1-master.
single shot event recover delay	Defines the time a Single Shot Event from an IO-Link device will be shown on PROFIBUS.
	00 = 5 sec. **A**
	01 = 30 sec.
	10 = 5 min.
	11 = 15 min.

Table 11: Parameters of the IOLMM (slot 1)

Parameter name	**Value/ Meaning**
port x: cycle mode	00 = free running **A** The IO-Inik master calculates the quickest possible IO-Link cycle time.
	01 = synchronous The cylce time is defined per port through the parameter "port x: cylce time" (see below). All IO-Link devices connected to the ports at which the same cylce time is set, start synchronously.
	10 = fixed value The IO-Link cylce is fixed, whereas the cylce time on which this value is based on, is set in parameter "port x: cycle time" (see below).
port x: cylce time	Setting the I/O-Link cycle time at the respective port. It is only valid, if the parameter "cylce mode" (see above) is set to the values "fixed value" or "synchronous". – Steps 0.1 ms: 0000 1111 = 1.5 ms to 0011 1111 = 6.3 ms – Steps 0.4 ms: 0010 0000 = 6.4 ms to 0111 1111 = 31.6 ms – Steps 1.6 ms: 1000 0000 = 32.0 ms to 1011 1111 = 132.8 ms

Parameters of slots 2 to 5, IO-Link device module (IOLDM)

Note

The parameters for the IO-Link device modules (slot 2 to slot 5) always depend on the connected device.

Generic IO-Link devices

Note

Sensors which are not part of the IO-Link master's GSD-file (e.g. sensors from 3rd-party-manufaturers) are treated as generic IO-Link devices.
Please observe, that the selected data width in the hardware configurator has to be ≥ the process data width of the connected device. → Chapter 4, "Configuration of the IO-Link ports".

Table 12: Parameters of the generic IO-Link devices

A *default setting*

Parameter name	Value/ Meaning
Identification	00 = any device **A** The data width of the connected sensor has to match the data width of the configured one. In addition to that, the cylce time for the cycle modes "fixed value" and "synchronous" has to be ≥ the devices minimum cycle time .
	10 = same device type The connected sensor has to be the same as the configured one. Vendor- and device-ID have to match.
vendor	0 **A** to 32767 Enter the vendor-ID for the connected sensor (TURCK e. g. 317).
device-ID 1 to device-ID 3	0 **A** to 255 Enter the device-ID for the connected sensor.
The following parameters describe the IO-Link index 1 (subindex 1 to 12), which, in principle, hass to be supported by all IO-Link devices. If this index is used for the sensors' parameterization or not, depends on the respective sensor. Please find the meaning of the subindices in the documentaion for the respective sensor.	
parametrization IO-Link Index 1	Defines whether (and if yes, which) parameter settings from "parameter in subindex 1" to "parameter in subindex 12" should be downloaded to the connected device. 0000 = inactive **A** 0001 = write subindex 1 0010 = write subindex 1 to 2 ... 1100 = write subindex 1 to 12

Table 12: Parameters of the generic IO-Link devices

Parameter name	Value/ Meaning
Parameter in subindex 1	Parameter settings for the sensor's subindices.
...	
Parameter in subindex 12	

IO-Link sensors from TURCK

The IO-Link TURCK sensors are integrated in the GSD-file of the SDPX-ILO4-0001. This assures customer-friendly parameterization of TURCK-devices via GSD.

Figure 13: Example-parameters of TURCK-sensors

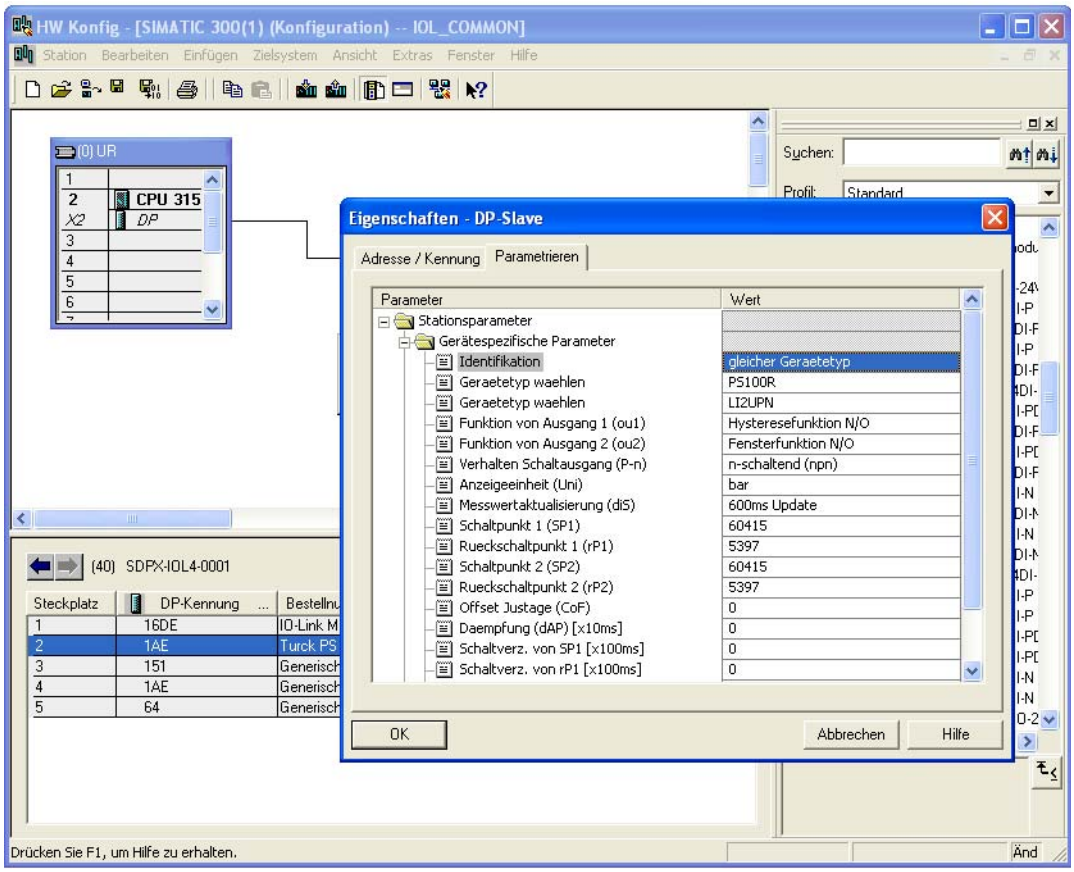


Table 13: Parameters of the generic IO-Link devices

A *default settings*

Parameter name	Value/ Meaning
Identification	00 = any device The connected sensor has to be a PS- or TS-TURCK-sensor and it's data width has to match the data width of the configured sensor. In addition to that, the cylce time for the cycle modes "fixed value" and "synchronous" has to be ≥ the devices minimum cycle time .
	10 = same device type The connected sensor has to be the same as the configured one. Vendor- and device-ID have to match.
select device	Please chose the correct TURCK device-type from the list.

Description of user data for acyclic services

The following instances are defined for the IO-Link master module SDPX-IOL4-001:

- Gateway Application Instance (slot 0)
- Module Application Instance (slot 1)

Gateway Application Instance, Slot 0

Table 14: Gateway Application Instance

Index	IM_INDEX FI_INDEX	Remark
255	65000	Identification & Maintaining-services, I&M0 acc. to PROFIBUS-DP

Module Application Instance, Slot 1

Table 15: Module Application Instance

Index	IM_INDEX FI_INDEX	Remark
255	65099	IOL-M directory, acc. to IO-Link Integration Part 1: PROFIBUS and PROFINET
255	65098	Client Access Point (CAP) for IOL_CALL via Profibus C2-connection, acc. to IO-Link Integration Part 1: PROFIBUS and PROFINET, e.g. for parameterization with DTM/FDT
254	65098	Client Access Point (CAP) for IOL_CALL via Profibus C1-connection, acc. to IO-Link Integration Part 1: PROFIBUS and PROFINET, e.g. for IOL_CALL function block
253	65098	
252	65098	
251	65098	

4 Connection to a Siemens Step 7 - usage of the TURCK-example program

Introduction **2**

Electronic Device Data Sheets (GSD) **3**

Application example with Siemens PLC and FB 102 (IO-Link CALL) **4**

Application example - prerequisites 4
– Used hardware 4
– Used software 4
The example project 4
– Opening the example project 5
– Hardware configuration 5
– Configuration of the IOLMM (IO-Link master module) 6
– Configuration of the IO-Link ports 6
– Configuration of the IO-Link ports in this example 7
– Example for the parameterization of a generic sensor 8
– Using the function block 10
– Example accesses with IOL_CALL 11
– Deactivation of write protection (index 59) 15

Introduction

This chapter describes the connection of the IO-Link master SDPX-IOL4-0001 to a Siemens PLC S7 (C1-master), the parameterization of the IO-Link master and the connected IO-Link devices per GSD as well as a description of the IO-Link function block "IO-Link CALL" for the S7.

The access to the IO-Link master via Ethernet-PROFIBUS-interface PB-XEPI (C2-master incl. communication-DTM) and TURCK-DTM is described in the following chapter, Chapter 5.

Note

The SDPX-IOL4-0001 can only be used as PROFIBUS-DP-Slave. The module has no DP-master function.

All manufacturers of control systems offer plug-in network cards for their PLCs, to which the SDPX-IOL4-0001 can easily be connected. Furthermore, it is possible to use a PC as a master if it has an appropriate PC PROFIBUS card.

Please refer to the respective manuals supplied by manufacturers for detailed information concerning individual control systems and automation devices.

Attention

The network and PC cards must comply with standards defined in PROFIBUS-DP DIN 19 245 Part 3.

The designations used in this manual for programmable logic controllers and software programs are registered and protected trademarks belonging to the respective manufacturer.

Electronic Device Data Sheets (GSD)

The SDPX-IOL4-0001 is integrated into PROFIBUS structures using electronic device data sheets (GSD).

Note

The actual version of the GSD-file "TRCKFF2D.gs×" can be downloaded from our TURCK homepage www.turck.com.
It is also possible to gain updates by downloading the files from the PROFIBUS User Organization's homepage: www.profibus.com.

Application example with Siemens PLC and FB 102 (IO-Link CALL)

Application example - prerequisites

Used hardware

- Siemens S7, CPU 315-2AG10-0AB0
- TURCK IO-Link master SDPX-IOL4-0001, address 40
  - IO-Link Port 1 (slot 2): TURCK pressure sensor, PS100R-501-LI2UPN8X-H1141
  - IO-Link Port 2 (slot 3): not used
  - IO-Link Port 3 (slot 4): Siemens ultra sonic sensor, 6GR6333-3KS00
  - IO-Link Port 4 (slot 5): not used

Used software

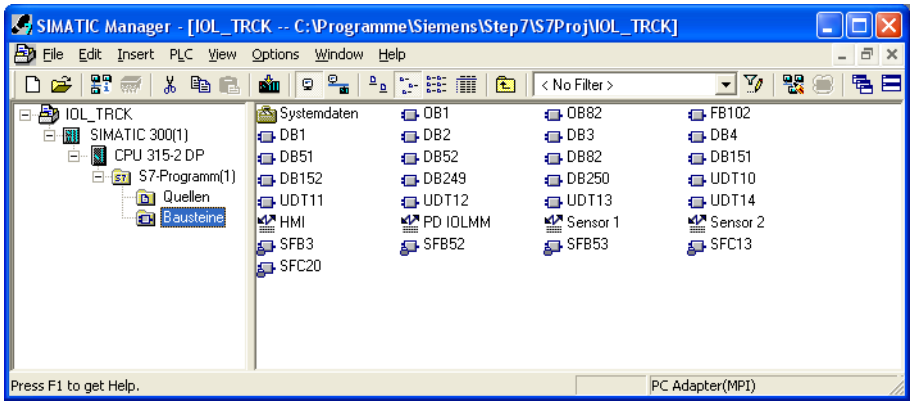
- SIMATIC Manager, Step 7, version 5.4, SP3
- example project "IOL-TRCK" in archive IOL_TRCK_jjjj.mm.tt.zip, including function block IO-Link CALL (TURCK FB 102)

The example project

The project "IOL-TRCK" describes the usage of the function block IO-Link CALL (TURCK FB102) for SPDU-communication in IO-Link by means of a simple example.

Besides the FB102, miscellaneous data blocks (DBs), User Defined Data Types (UDTs) and Siemens system functions (SFCs) as well as system function blocks (SFBs) are used in the example project. They are all necessary for the operation of the example project but their exact function will not be described here.

Figure 14: The TURCK example project



The variable tables "HMI", "PDIOLMM", "Sensor1" etc. are, above all, used to handle the function block and to visualize several program sequences and the process data.

Note

For detailed information about Siemens SFCs and SFBs as well as about the usage of DBs and UDTs, please read the Online-help for the SIMATIC software.

Opening the example project

Retrieve the archive IOL_TRCK_jjjj.mm.tt.zip in the SIMATIC Manager using the "File → Retrieve" command and open the example project "IOL-TRCK".

Hardware configuration

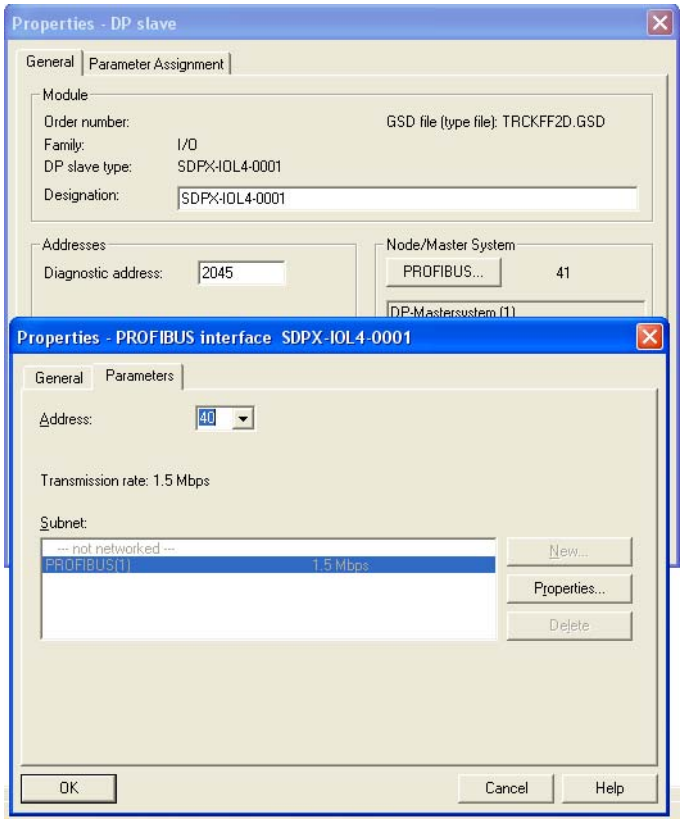
Note

The hardware configuration used in the example has to be adapted by each user to his own hardware configuration. In the following description this adaptation is also done according to the hardware configuration mentioned above.

1 Open the Hardware configurator "HW Config" and adapt the configured CPU to the actual configuration. In this example a CPU 315-2AG10-0AB0 is used.

2 Open the "Properties DP-Slave" dialog by double-clicking the symbol of the SDPX-IOL4-0001. Open the dialog box "Properties - PROFIBUS Interface SDPX-IOL4-0001" via the button "PROFIBUS" under "Node/Master System". In the register tab "Parameters" the node address for the IO-Link master will be adapted (in this example address 40).

Figure 15: Setting the PROFIBUS address



3 Even the in -and output addresses of the IO-Link master module IOLMM (slot 1) and of the 4 IO-Link ports (slot 2 to 5) have to be adapted to the application (see also Figure 18: ”Hardware-configuration with generic sensor”).

Configuration of the IOLMM (IO-Link master module)

Slot 1 of the modular slave contains the IO-Link master module (IOLMM). The IOLMM serves as gateway between IO-Link and PROFIBUS-DP. It handles the IO-Link data of the IO-Link ports for further processing on PROFIBUS.

Parameterization of the IOLMM

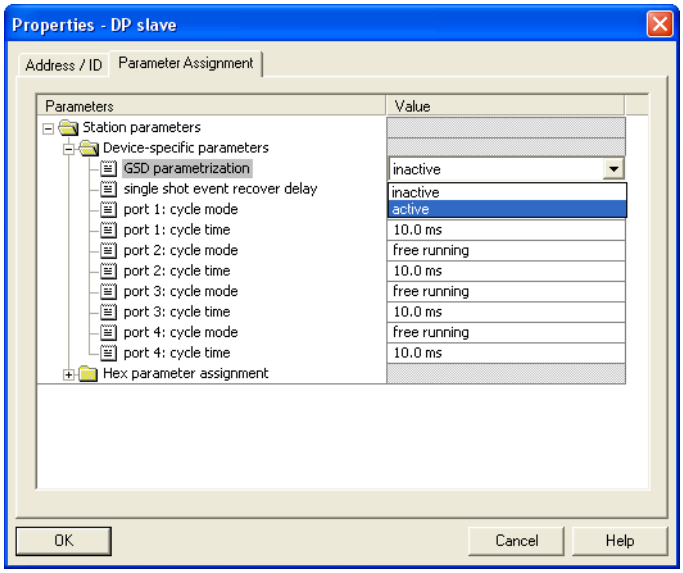
The parameters of the IO-Link master module (slot 1) control the communication of the complete SDPX-IOL4-0001 including all connected devices.

The parameters of slot 1 (IOLMM) have to be set according to the application, see also Chapter 3, ”Parameterization”, page 3-19.

Note

Please be sure that the parameter ”GSD parametrization” is set to active. Otherwise the parameterization via GSD done in the following in the hardware configurator will be ignored.

Figure 16: GSD-parameterization



Configuration of the IO-Link ports

The 4 ports of the IO-Link master (slot 2 to slot 5) can be operated either in IO-Link mode or in SIO mode (see also ”GSD-file”, page 3-15).
The determining factor for the function mode of the ports is their configuration:

General

- IO-Link mode:
  If the port is to be used in the IO-Link mode, a sensor with a process data width > 0 has to be selected from the hardware catalog.
  IO-Link sensors from TURCK [TURCK … (IOL mode)] are described in the GSD-file of the IO-Link master and can be comfortably parameterized via GSD-parameters.
  Sensors from 3rd-party-manufacturers are represented as generic IO-Link devices with a maximum number of 32 byte input- and/or output data Figure 17: ”Parameterization via GSD”.

Note

The selected generic device has to be a device with a process data width ≥ the process data width of the connected sensor.

For the meaning of the parameters (IO-Link, index 1, subindex x), please read the documentation for the respective sensor Figure 19: ”Extract from the documentation of the used Siemens sensor”.

- SIO mode
  If the port has to be operated in SIO mode, please select devices with 0 byte of process data [TURCK … (SIO mode) or Generic 0 Byte (SIO mode)] from the hardware catalog.

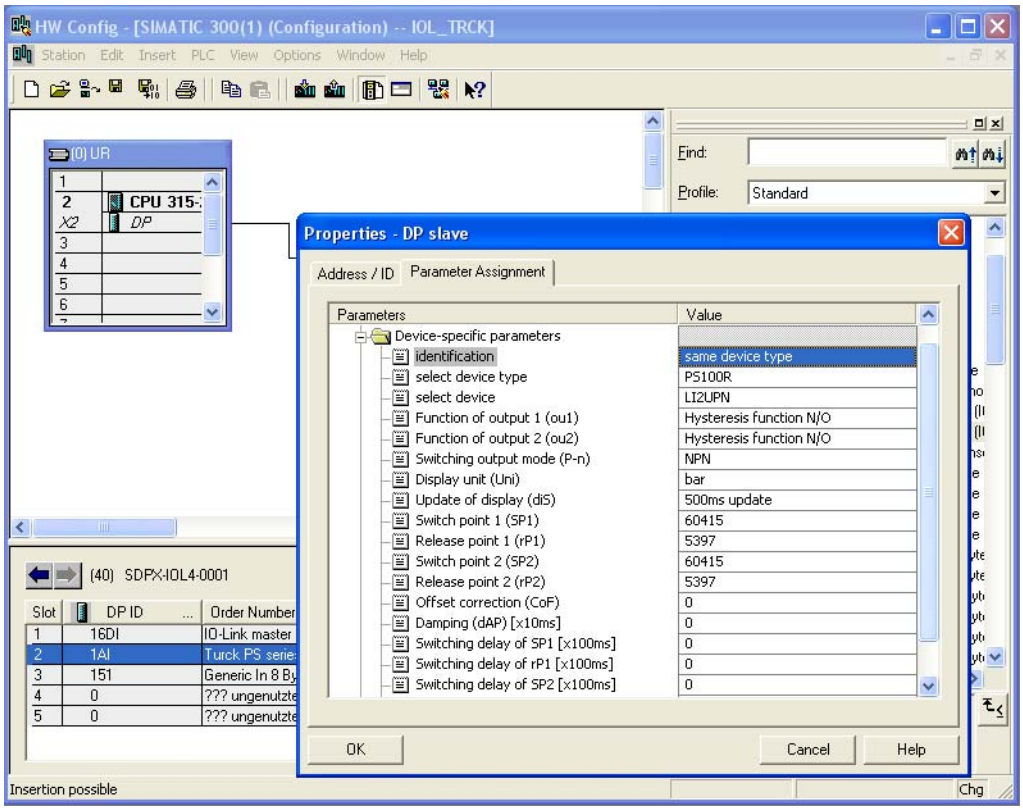
Configuration of the IO-Link ports in this example

1 A TURCK pressure sensor (PS100R-501-LI2UPN8X-H1141) is connected to IO-Link port 1 (slot 2) which has to be operated in IO-Link mode.
The default-entry "Generic In 8 Byte" at slot 2 is therefore replaced by the sensor Turck PS series (IOL mode) from the hardware catalog.

Parameterization of the TURCK-sensors

The TURCK sensor is parameterized according to the application as shown for example in Figure 17: ”Parameterization via GSD”. A description of the sensor-parameters can be found in the respective sensor-documentation under www.turck.com.

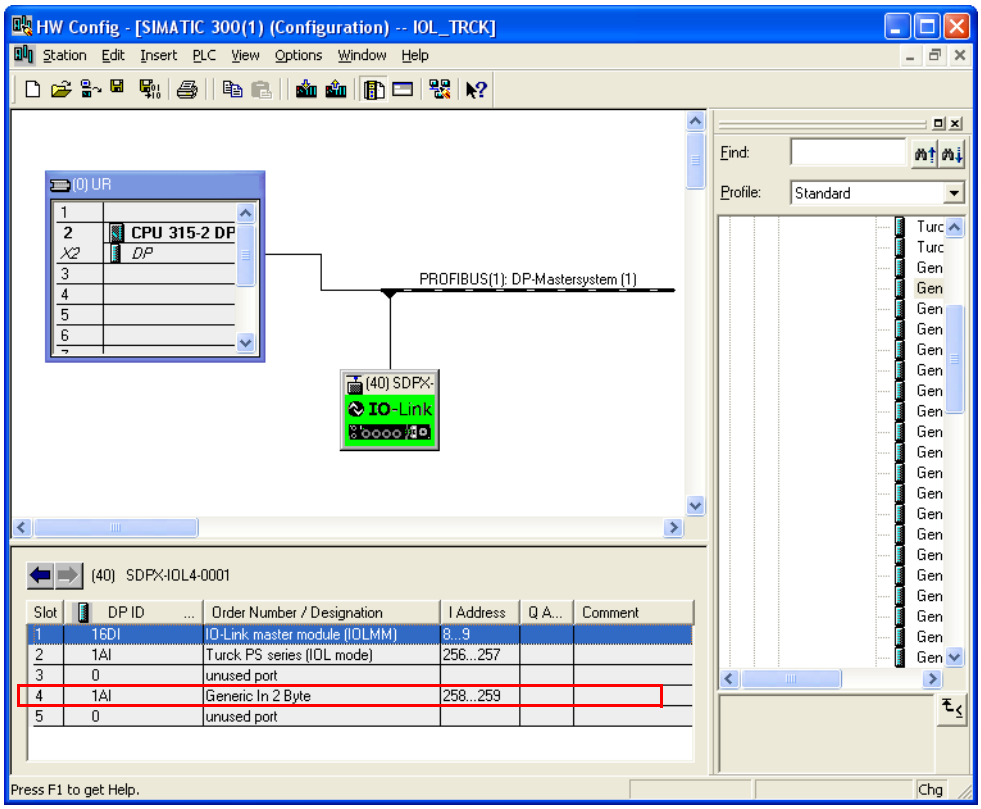
Figure 17: Parameterization via GSD



2 A Siemens ultra sonic sensor, PXS310C M18 IO-Link (6GR6333-3KS00) is connected to IO-Link port 3 (slot 4). It should also be used in IO-Link mode.
The sensor is not part of the GSD-file of the TURCK IO-Link master and can therefore only be inserted as generic sensor (see “Configuration of the IO-Link ports“). According to the vendor, it has 2 byte of process data.

The default-entry "Generic In 8 Byte" at slot 4 is therefore replaced by "Generic In 2 Byte" from the hardware catalog.

Figure 18: Hardware-configuration with generic sensor


HW Config - [SIMATIC 300(1) (Configuration) -- IOL_TRCK]
Station Edit Insert PLC View Options Window Help
(0) UR
CPU 315-2 DP
DP
PROFIBUS(1): DP-Mastersystem (1)
(40) SDPX-
IO-Link
Find:
Profile:
Standard
(40) SDPX-IOL4-0001
Slot DP ID Order Number / Designation I Address Q A... Comment
1 16DI IO-Link master module (IOLMM) 8...9
2 1AI Turck PS series (IOL mode) 256...257
3 0 unused port
4 1AI Generic In 2 Byte 258...259
5 0 unused port
Press F1 to get Help.
Chg

Example for the parameterization of a generic sensor

The parameterization of a generic sensor via the hardware configurator is only possible if the sensor provides parameters which can be set in IO-Link index 1.

According to the vendor documentation, the Siemens sensor used in this example provides the following parameters in IO-Link index 1.

Figure 19: Extract from the documentation of the used Siemens sensor

Index area parameterisation						
Index	**Sub-Index**	**Format**	**Access rights**	**Function**	**Range**	**Remarks**
1	1	IntegerT (8 Bit)	R	temperature	-25 … +105 °C	internal temperature of the sensor
1	2	UIntegerT (8 Bit)	R/W	filter depth	0 … 255	factory setting = 3 *)
1	7	IntegerT (16 Bit)	R/W	measuring range near / start (MBn)	110 … 1000 mm	max. setpoint < final value factory setting = 110
1	9	IntegerT (16 Bit)	R/W	measuring range far / end (MBf)	110 … 1000 mm	min. setpoint > initial value factory setting = 1000

In order to set the "measuring range near /start (MBn)" from 110 mm to 500 mm, the following value has to be written to index 1, subindex 7 + 8:

500 mm = 0000 0001 1111 0100 = 0×01F4

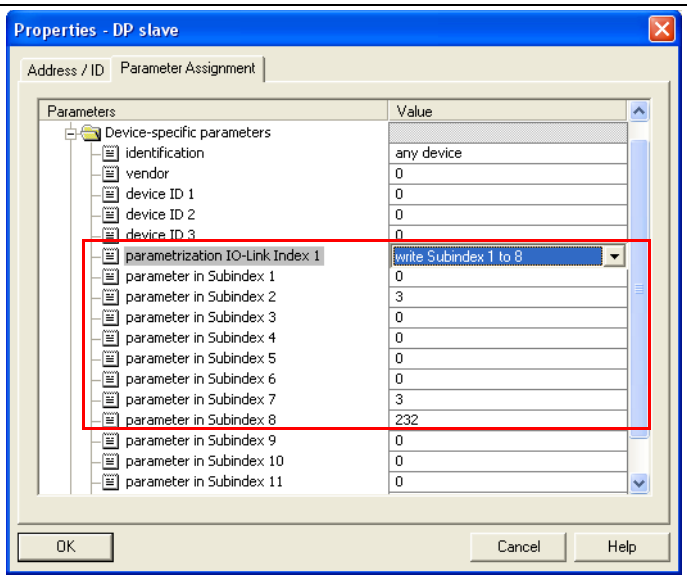
- MSB subindex 7 = 0×01 = 1
- LSB subindex 8 = 0×F4 = 244

Whether (and if yes, which) parameter bytes are really written, depends on the setting for the parameter "parameterization IO-Link Index1". In this case, the option "write Subindex 1 to 8" has to be chosen.

Attention

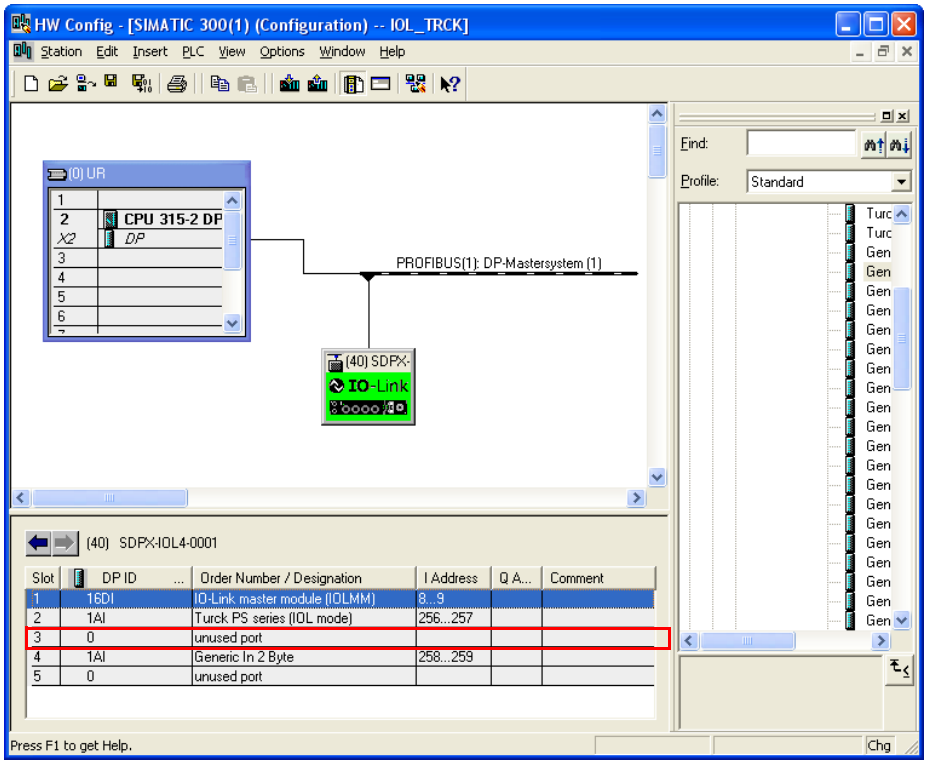
During the writing process, all parameter in the selected subindices are overwritten. This means that all subindices (here in the example 1 to 8) have to contain the desired parameter values in order not to be overwritten with "0".

Figure 20: Writing the parameter indices



3 IO-Link ports which are eventually not used can be configured as "unused port" or as "Generic 0 Byte (SIO mode)".

Figure 21: Unused ports



Using the function block

The IO-Link function block IOL_Call is specified in the IO-Link Specification.

The TURCK FB102 only differs from the specification in some variable names (the variable names acc. to the specification are written in brackets behind those of the example project).

Input variables

Table 16: Input variables

DO_IT (REQ)	BOOL	A rising edge activates the send command.
ID	WORD	Starting address of the input data of the IO-Link master module (slot 1). In the example program address 8 (Figure 21:).
Index_CAP	INT	Specification of the function block instance: 251 to 254 (see also page 3-24).
RD_WR	BOOL	0 = read access 1 = write access
PORT (ENTITY_PORT)	INT	Address of the IO-Link port, which has to be accessed
IOL_INDEX	INT	Specification of the number of the IO-Link index, which has to be read or written
IOL_SUBINDEX	INT	Specification of a possible subindex.
LEN _WRITE		Specification of the length of the data to be written
LEN_ READ_MAX		Maximum number of data to be read during a read-access

Output variables

Table 17: Output variables

DONE_VALID	BOOL	The read or write access has been executed.
BUSY	BOOL	The read or write access is actually executed.
ERROR	BOOL	An error occurred during the read and/or write access.
STATUS	DWORD	PROFIBUS-DPV1 error message (acc. to PROFIBUS-DP Specification), which show errors in the acyclic communication. Busy = 0xFFFFFFFF
IOL_STAUTS	DWORD	IO-Link error message (acc. to IO-Link Specification), which concern the communication between IO-Link master and connected devices.
LEN_READ	INT	Length of the read data

Example accesses with IOL_CALL

In this example, the variable table "HMI" serves to visualize the procedure of the read and write access via IOL_CALL. The sensors' process data are shown in the variable tables "Sensor1" or "Sensor2", the process data of the IO-Link master in "PD IOLMM".

As mentioned above, please read the sensor documentation for the assignment of the sensor's SPDU-indices.

Read access

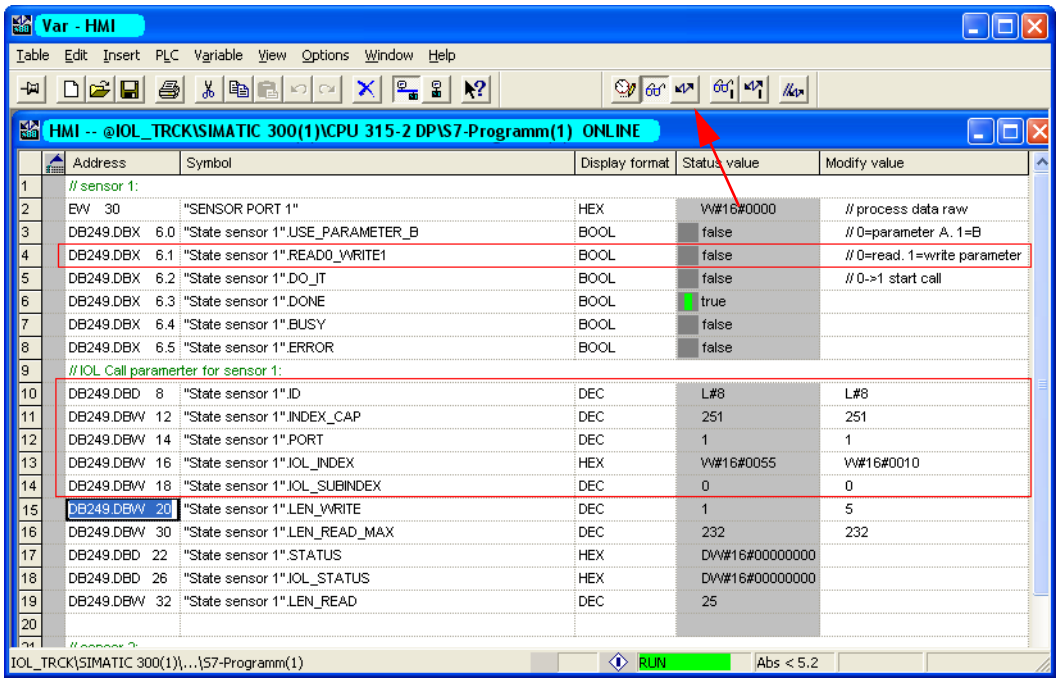
Reading out the vendor name (index 0x10) from TURCK pressure sensor, PS100R-501-LI2UPN8X-H1141 at IO-Link port 1.

1 Please write the function block's input variables via "Modify variable" as follows (description see above):

Table 18: Example for input variables

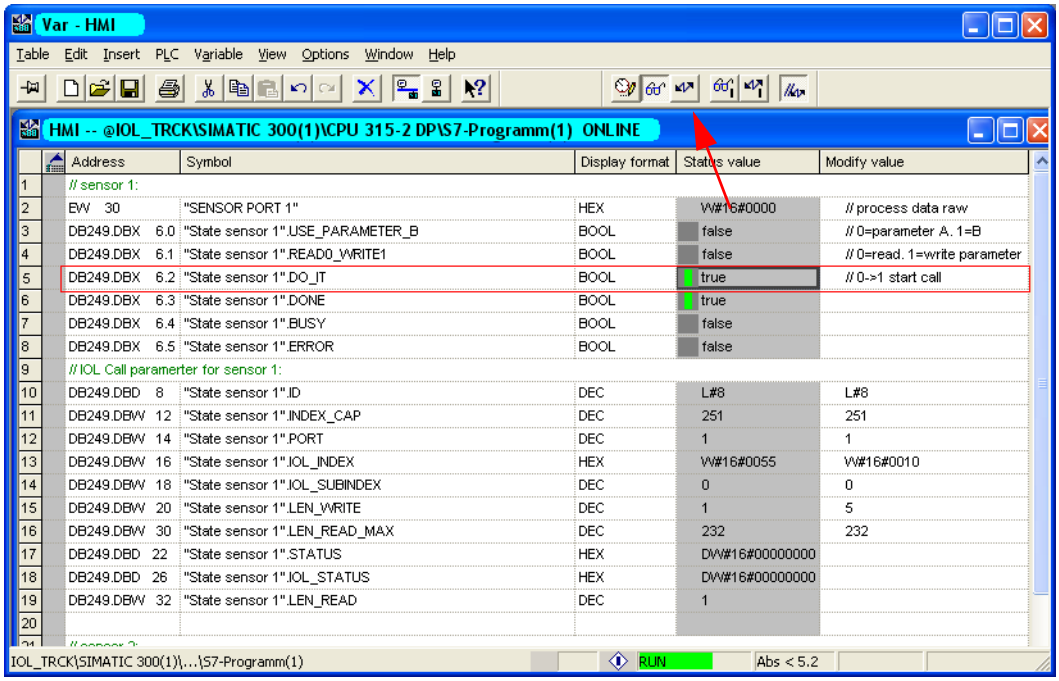
READ0_WRITE1	0
ID	Addr. 8
Index_CAP	251
PORT (ENTITY_PORT)	1
IOL_INDEX	0×10
LEN_READ	1

Figure 22: Input variables for the read access


Var - HMI
Table Edit Insert PLC Variable View Options Window Help
HMI -- @IOL_TRCK\SIMATIC 300(1)\CPU 315-2 DP\S7-Programm(1) ONLINE
Address | Symbol | Display format | Status value | Modify value
1 // sensor 1:
2 EW 30 "SENSOR PORT 1" HEX W#16#0000 // process data raw
3 DB249.DBX 6.0 "State sensor 1".USE_PARAMETER_B BOOL false // 0=parameter A, 1=B
4 DB249.DBX 6.1 "State sensor 1".READ0_WRITE1 BOOL false // 0=read, 1=write parameter
5 DB249.DBX 6.2 "State sensor 1".DO_IT BOOL false // 0->1 start call
6 DB249.DBX 6.3 "State sensor 1".DONE BOOL true
7 DB249.DBX 6.4 "State sensor 1".BUSY BOOL false
8 DB249.DBX 6.5 "State sensor 1".ERROR BOOL false
9 // IOL Call parameter for sensor 1:
10 DB249.DBD 8 "State sensor 1".ID DEC L#8 L#8
11 DB249.DBW 12 "State sensor 1".INDEX_CAP DEC 251 251
12 DB249.DBW 14 "State sensor 1".PORT DEC 1 1
13 DB249.DBW 16 "State sensor 1".IOL_INDEX HEX W#16#0055 W#16#0010
14 DB249.DBW 18 "State sensor 1".IOL_SUBINDEX DEC 0 0
15 DB249.DBW 20 "State sensor 1".LEN_WRITE DEC 1 5
16 DB249.DBW 30 "State sensor 1".LEN_READ_MAX DEC 232 232
17 DB249.DBD 22 "State sensor 1".STATUS HEX DW#16#00000000
18 DB249.DBD 26 "State sensor 1".IOL_STATUS HEX DW#16#00000000
19 DB249.DBW 32 "State sensor 1".LEN_READ DEC 25
20
IOL_TRCK\SIMATIC 300(1)\...\S7-Programm(1)
RUN
Abs < 5.2

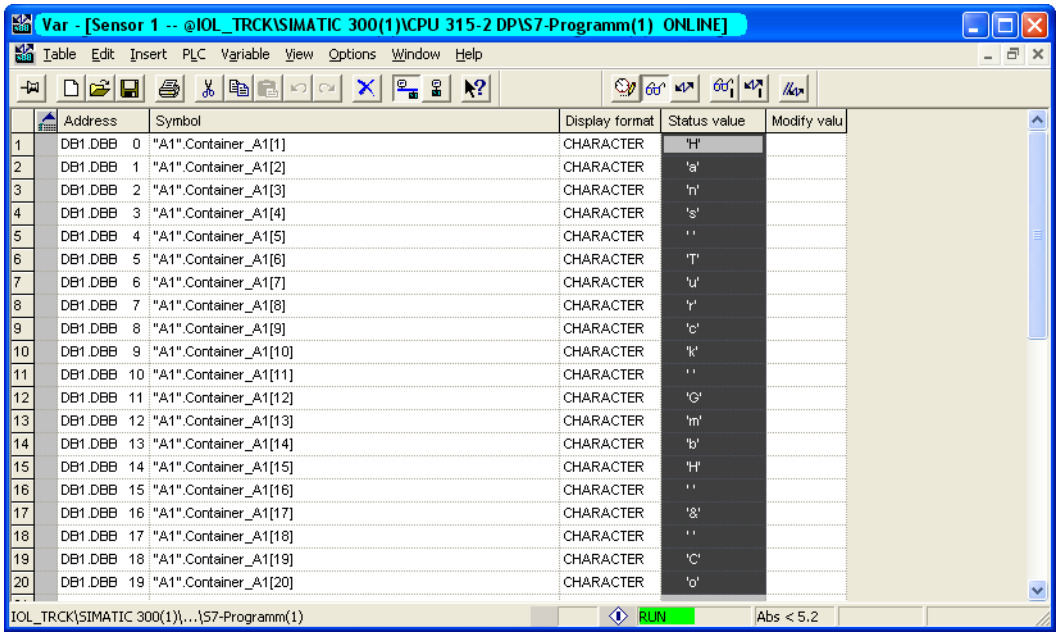
2 After this, the read access has to be activated using a rising edge at "DO_IT":

Figure 23: Activation of the read access


Var - HMI
Table Edit Insert PLC Variable View Options Window Help
HMI -- @IOL_TRCK\SIMATIC 300(1)\CPU 315-2 DP\S7-Programm(1) ONLINE
Address Symbol Display format Status value Modify value
1 // sensor 1:
2 EW 30 "SENSOR PORT 1" HEX W#16#0000 // process data raw
3 DB249.DBX 6.0 "State sensor 1".USE_PARAMETER_B BOOL false // 0=parameter A, 1=B
4 DB249.DBX 6.1 "State sensor 1".READ0_WRITE1 BOOL false // 0=read, 1=write parameter
5 DB249.DBX 6.2 "State sensor 1".DO_IT BOOL true // 0->1 start call
6 DB249.DBX 6.3 "State sensor 1".DONE BOOL true
7 DB249.DBX 6.4 "State sensor 1".BUSY BOOL false
8 DB249.DBX 6.5 "State sensor 1".ERROR BOOL false
9 // IOL Call paramerter for sensor 1:
10 DB249.DBD 8 "State sensor 1".ID DEC L#8 L#8
11 DB249.DBW 12 "State sensor 1".INDEX_CAP DEC 251 251
12 DB249.DBW 14 "State sensor 1".PORT DEC 1 1
13 DB249.DBW 16 "State sensor 1".IOL_INDEX HEX W#16#0055 W#16#0010
14 DB249.DBW 18 "State sensor 1".IOL_SUBINDEX DEC 0 0
15 DB249.DBW 20 "State sensor 1".LEN_WRITE DEC 1 5
16 DB249.DBW 30 "State sensor 1".LEN_READ_MAX DEC 232 232
17 DB249.DBD 22 "State sensor 1".STATUS HEX DW#16#00000000
18 DB249.DBD 26 "State sensor 1".IOL_STATUS HEX DW#16#00000000
19 DB249.DBW 32 "State sensor 1".LEN_READ DEC 1
20
IOL_TRCK\SIMATIC 300(1)\...\S7-Programm(1)
RUN
Abs < 5.2

3 The vendor name is now to be read in variable table "Sensor1".

Figure 24: Read data in "Sensor1"


Var - [Sensor 1 -- @IOL_TRCK\SIMATIC 300(1)\CPU 315-2 DP\S7-Programm(1) ONLINE]
Table Edit Insert PLC Variable View Options Window Help
Address Symbol Display format Status value Modify valu
1 DB1.DBB 0 "A1".Container_A1[1] CHARACTER 'H'
2 DB1.DBB 1 "A1".Container_A1[2] CHARACTER 'a'
3 DB1.DBB 2 "A1".Container_A1[3] CHARACTER 'n'
4 DB1.DBB 3 "A1".Container_A1[4] CHARACTER 's'
5 DB1.DBB 4 "A1".Container_A1[5] CHARACTER ' '
6 DB1.DBB 5 "A1".Container_A1[6] CHARACTER 'T'
7 DB1.DBB 6 "A1".Container_A1[7] CHARACTER 'u'
8 DB1.DBB 7 "A1".Container_A1[8] CHARACTER 'r'
9 DB1.DBB 8 "A1".Container_A1[9] CHARACTER 'c'
10 DB1.DBB 9 "A1".Container_A1[10] CHARACTER 'k'
11 DB1.DBB 10 "A1".Container_A1[11] CHARACTER ' '
12 DB1.DBB 11 "A1".Container_A1[12] CHARACTER 'G'
13 DB1.DBB 12 "A1".Container_A1[13] CHARACTER 'm'
14 DB1.DBB 13 "A1".Container_A1[14] CHARACTER 'b'
15 DB1.DBB 14 "A1".Container_A1[15] CHARACTER 'H'
16 DB1.DBB 15 "A1".Container_A1[16] CHARACTER ' '
17 DB1.DBB 16 "A1".Container_A1[17] CHARACTER '&'
18 DB1.DBB 17 "A1".Container_A1[18] CHARACTER ' '
19 DB1.DBB 18 "A1".Container_A1[19] CHARACTER 'C'
20 DB1.DBB 19 "A1".Container_A1[20] CHARACTER 'o'
IOL_TRCK\SIMATIC 300(1)\...\S7-Programm(1)
RUN
Abs < 5.2

Write access

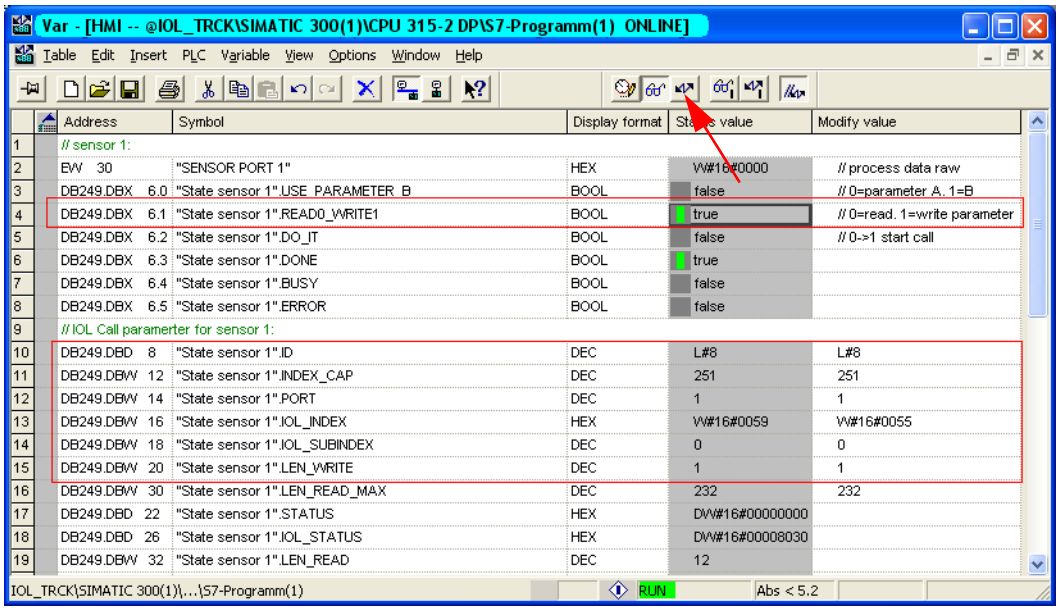
Changing of parameter "Update of display (diS)" (index 55) to value 0x03 (50 ms update/ display 180 deg) from TURCK pressure sensor, PS100R-501-LI2UPN8X-H1141 at IO-Link port 1.

1 Please write the function block's input variables via "Modify variable" as follows (description see above):

Table 19: Example input variables

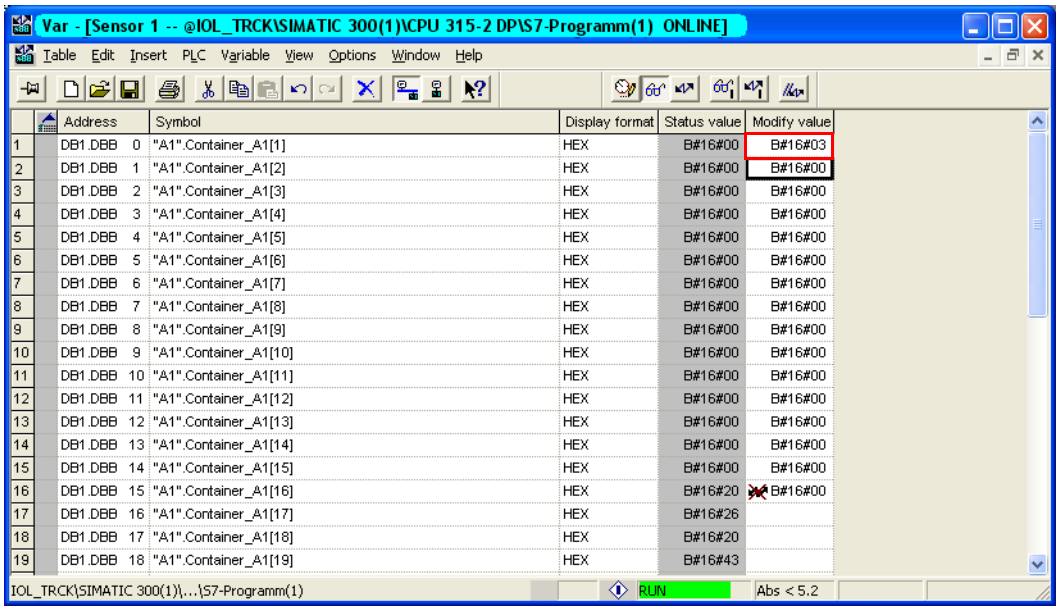
READ0_WRITE1	1
ID	Addr. 8
Index_CAP	251
PORT (ENTITY_PORT)	1
IOL_INDEX	0×55
LEN_READ	1

Figure 25: Input variables for write access


Var - [HMI -- @IOL_TRCK\SIMATIC 300(1)\CPU 315-2 DP\S7-Programm(1) ONLINE]
Table Edit Insert PLC Variable View Options Window Help
Address Symbol Display format Modify value
// sensor 1:
EW 30 "SENSOR PORT 1" HEX W#16#0000 // process data raw
DB249.DBX 6.0 "State sensor 1".USE_PARAMETER_B BOOL false // 0=parameter A, 1=B
DB249.DBX 6.1 "State sensor 1".READ0_WRITE1 BOOL true // 0=read, 1=write parameter
DB249.DBX 6.2 "State sensor 1".DO_IT BOOL false // 0->1 start call
DB249.DBX 6.3 "State sensor 1".DONE BOOL true
DB249.DBX 6.4 "State sensor 1".BUSY BOOL false
DB249.DBX 6.5 "State sensor 1".ERROR BOOL false
// IOL Call paramerter for sensor 1:
DB249.DBD 8 "State sensor 1".ID DEC L#8 L#8
DB249.DBW 12 "State sensor 1".INDEX_CAP DEC 251 251
DB249.DBW 14 "State sensor 1".PORT DEC 1 1
DB249.DBW 16 "State sensor 1".IOL_INDEX HEX W#16#0059 W#16#0055
DB249.DBW 18 "State sensor 1".IOL_SUBINDEX DEC 0 0
DB249.DBW 20 "State sensor 1".LEN_WRITE DEC 1 1
DB249.DBW 30 "State sensor 1".LEN_READ_MAX DEC 232 232
DB249.DBD 22 "State sensor 1".STATUS HEX DW#16#00000000
DB249.DBD 26 "State sensor 1".IOL_STATUS HEX DW#16#00008030
DB249.DBW 32 "State sensor 1".LEN_READ DEC 12
IOL_TRCK\SIMATIC 300(1)\...\S7-Programm(1)
RUN
Abs < 5.2

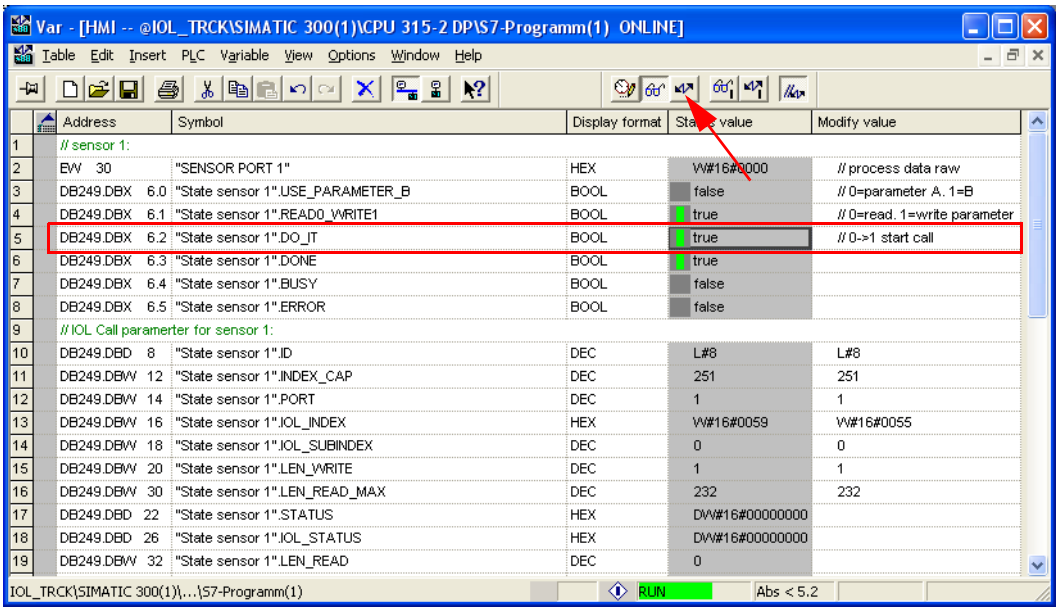
2 The value to be written (0x03) is entered in the variable table, column "modify value", and then written to the module via "Modify variable".

Figure 26: Modify value for index 0×55


Var - [Sensor 1 -- @IOL_TRCK\SIMATIC 300(1)\CPU 315-2 DP\S7-Programm(1) ONLINE]
Table Edit Insert PLC Variable View Options Window Help
Address Symbol Display format Status value Modify value
1 DB1.DBB 0 "A1".Container_A1[1] HEX B#16#00 B#16#03
2 DB1.DBB 1 "A1".Container_A1[2] HEX B#16#00 B#16#00
3 DB1.DBB 2 "A1".Container_A1[3] HEX B#16#00 B#16#00
4 DB1.DBB 3 "A1".Container_A1[4] HEX B#16#00 B#16#00
5 DB1.DBB 4 "A1".Container_A1[5] HEX B#16#00 B#16#00
6 DB1.DBB 5 "A1".Container_A1[6] HEX B#16#00 B#16#00
7 DB1.DBB 6 "A1".Container_A1[7] HEX B#16#00 B#16#00
8 DB1.DBB 7 "A1".Container_A1[8] HEX B#16#00 B#16#00
9 DB1.DBB 8 "A1".Container_A1[9] HEX B#16#00 B#16#00
10 DB1.DBB 9 "A1".Container_A1[10] HEX B#16#00 B#16#00
11 DB1.DBB 10 "A1".Container_A1[11] HEX B#16#00 B#16#00
12 DB1.DBB 11 "A1".Container_A1[12] HEX B#16#00 B#16#00
13 DB1.DBB 12 "A1".Container_A1[13] HEX B#16#00 B#16#00
14 DB1.DBB 13 "A1".Container_A1[14] HEX B#16#00 B#16#00
15 DB1.DBB 14 "A1".Container_A1[15] HEX B#16#00 B#16#00
16 DB1.DBB 15 "A1".Container_A1[16] HEX B#16#20 B#16#00
17 DB1.DBB 16 "A1".Container_A1[17] HEX B#16#26
18 DB1.DBB 17 "A1".Container_A1[18] HEX B#16#20
19 DB1.DBB 18 "A1".Container_A1[19] HEX B#16#43
IOL_TRCK\SIMATIC 300(1)\...\S7-Programm(1) RUN Abs < 5.2

3 After this, the write access has to be activated using a rising edge at "DO_IT":

Figure 27: Activation of write access


Var - [HMI -- @IOL_TRCK\SIMATIC 300(1)\CPU 315-2 DP\S7-Programm(1) ONLINE]
Table Edit Insert PLC Variable View Options Window Help
Address Symbol Display format Status value Modify value
1 // sensor 1:
2 EW 30 "SENSOR PORT 1" HEX W#16#0000 // process data raw
3 DB249.DBX 6.0 "State sensor 1".USE_PARAMETER_B BOOL false // 0=parameter A, 1=B
4 DB249.DBX 6.1 "State sensor 1".READ0_WRITE1 BOOL true // 0=read, 1=write parameter
5 DB249.DBX 6.2 "State sensor 1".DO_IT BOOL true // 0->1 start call
6 DB249.DBX 6.3 "State sensor 1".DONE BOOL true
7 DB249.DBX 6.4 "State sensor 1".BUSY BOOL false
8 DB249.DBX 6.5 "State sensor 1".ERROR BOOL false
9 // IOL Call parameter for sensor 1:
10 DB249.DBD 8 "State sensor 1".ID DEC L#8 L#8
11 DB249.DBW 12 "State sensor 1".INDEX_CAP DEC 251 251
12 DB249.DBW 14 "State sensor 1".PORT DEC 1 1
13 DB249.DBW 16 "State sensor 1".IOL_INDEX HEX W#16#0059 W#16#0055
14 DB249.DBW 18 "State sensor 1".IOL_SUBINDEX DEC 0 0
15 DB249.DBW 20 "State sensor 1".LEN_WRITE DEC 1 1
16 DB249.DBW 30 "State sensor 1".LEN_READ_MAX DEC 232 232
17 DB249.DBD 22 "State sensor 1".STATUS HEX DW#16#00000000
18 DB249.DBD 26 "State sensor 1".IOL_STATUS HEX DW#16#00000000
19 DB249.DBW 32 "State sensor 1".LEN_READ DEC 0
IOL_TRCK\SIMATIC 300(1)\...\S7-Programm(1) RUN Abs < 5.2

4 The sensor's display should now be rotated about 180°.

Deactivation of write protection (index 59)

If a write access to an index (except for index 59) via IOL_CALL should not be possible, a write protection may most likely be activated in the connected sensor.
This is usually shown by the sensor sending an error code (e.g.: IOL_STATUS = 0×00008023 = access denied).

If necessary, this write protection has to be deactivated.
To do this, the "write protection" index of the sensor has to be written with the sensor's "release value". The index as well as the value to be written for deactivating the write protection depend on the respective sensor. This information can be found in the documentation of the respective device.

The write protection-index for the TURCK pressure sensor in the preceding application-example (page 4-4) is the **IO-Link write protection index 0×59**.

Table 20: Index 0×59 - write protection

Value Hex	Function
0×00	no write protection
0×01	Writing of parameters via IO-Link not possible (except for index 0x59)

5 Acyclic data exchange via PROFIBUS-DP C2-master and TURCK IO-Link DTM

Communication via DTM with C2-master 2

Used hardware 2
Used software 2
Hardware-configuration C2-master 2
– Adaptation of the IP-address for the PB-XEPI 3
Configuration of the CommDTM in PACTware™ 4
Configuration of the IO-Link master 5
– Parameterization via DTM 8
– Operation of the IO-Link master for testing purpose (without PLC) 9

Communication via DTM with C2-master

To be able to access the IO-Link master and the connected TURCK IO-Link sensors via TURCK IO-Link DTM, the usage of a PROFIBUS-DP master Class 2 (C2-master) is necessary.

The example described in the following shows, besides configuration, parameterization and diagnosis via DTM, also the measurement value representation for the IO-Link master or respectively for the connected TURCK-sensors.

Used hardware

- TURCK-PB-XEPI (Ethernet/ PROFIBUS - interface), EtherNet/IP-address 192.168.1.23
- TURCK-IO-Link master SDPXIOL4-0001, DP-address 40
  - IO-Link port 1 (slot 2): TURCK pressure sensor, PS100R-501-LI2UPN8X-H1141
  - IO-Link port 2 (slot 3): not used
  - IO-Link port 3 (slot 4): Siemens ultra sonic sensor, PXS310C M18 IO-Link (6GR6333-3KS00)
  - IO-Link port 4 (slot 5): not used

Used software

- PACTware™, version 3.6
- DTM for the PB-XEPI: CommDTM_PROFIBUS_DPV1 from Trebing & Himstedt, version 3.0.0.8
- TURCK-DTM for the IO-Link master SDPX-IOL4-0001
- TURCK-DTM for the TURCK-sensor PS100R-501-LI2UPN8X-H1141

The software PACTware™, the DTMs as well as the documentation for the devices can be downloaded free of charge from www.turck.com.

Hardware-configuration C2-master

The PB-XEPI is connected to the PC via EtherNet/IP.

Default IP-address: 169.254.0.1

Subnet: 255.255.0.0

The connection to PROFIBUS is done via a SUB-female connector.

Adaptation of the IP-address for the PB-XEPI

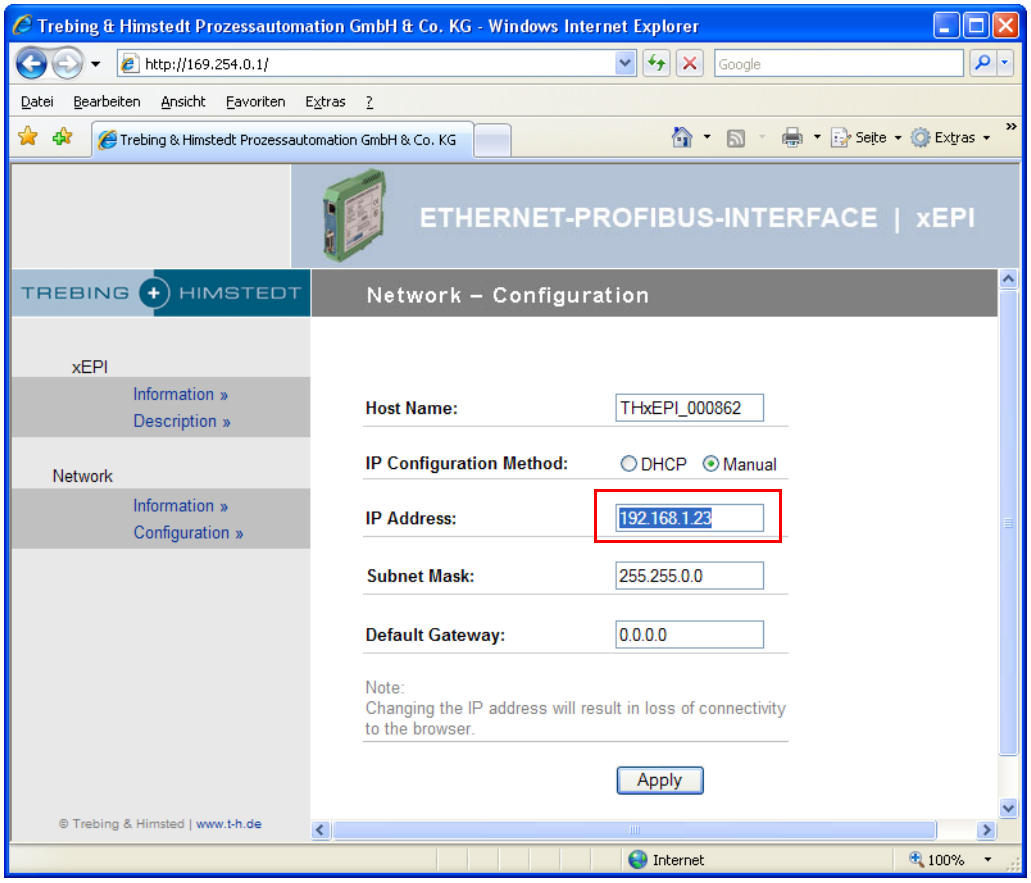
The PB-XEPI and the used PC have to be participants of the same network.

Note

For the adaptation of the network address of the PB-XEPI please read the respective manual (D301143).

In this example, the network address of the PB-XEPI is changed to **192.168.1.23** in accordance to the used network.

Figure 28: Web-server of the PB-XEPI



Configuration of the CommDTM in PACTware™

After the installation of the DTM for the PB-XEPI "CommDTM_PROFIBUS_DPV1", add it to your project.

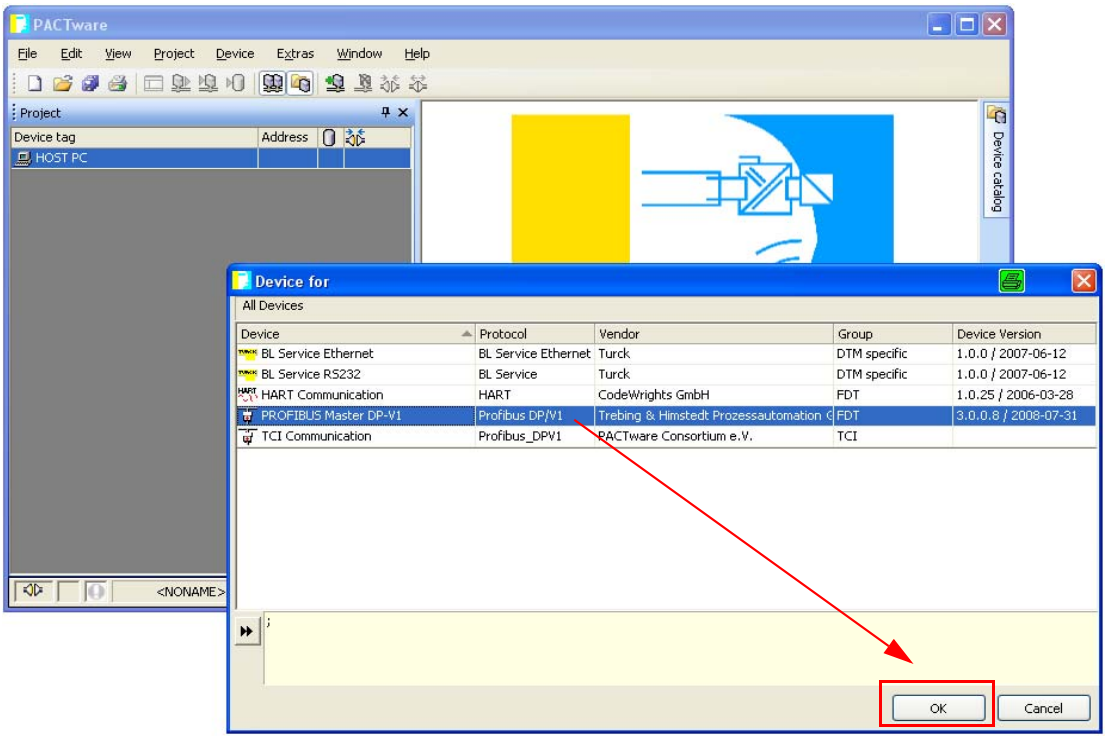


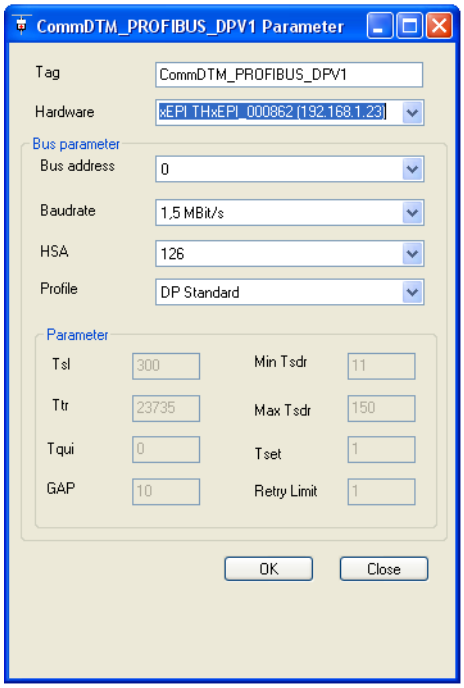
Figure 29: Adding the CommDTM to the project

A double-click onto the CommDTM opens the dialog box "CommDTM_PROFIBUS_DPV1 Parameter".

Activate the option "search for new hardware" under "Hardware". The DTM scans the EtherNet/IP-network for connected PB-XEPIs.

Select the device with the correct IP-address, if necessary, adapt the device's PROFIBUS-parameters to your PROFIBUS-network and confirm your selection with "OK".

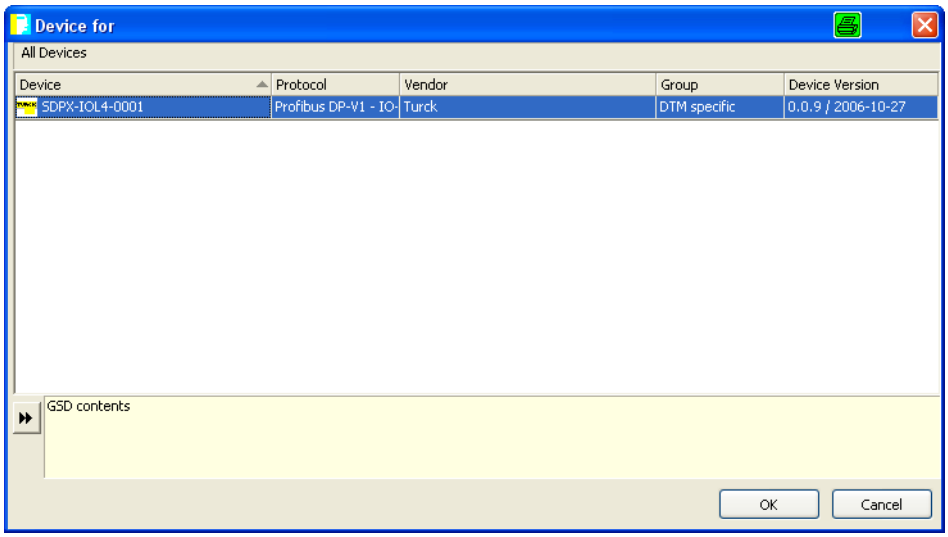
Figure 30: Parameters PB-XEPI



Configuration of the IO-Link master

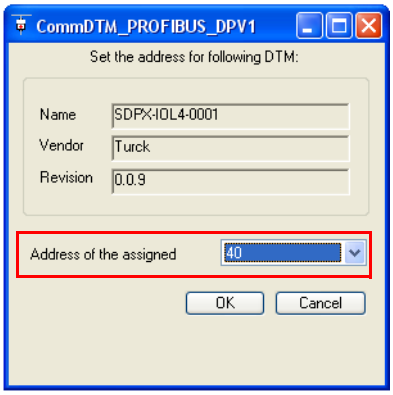
Add now the TURCK IO-Link master SPDX-IOL4-0001 to the project.

Figure 31: Add the IO-Link master to the project



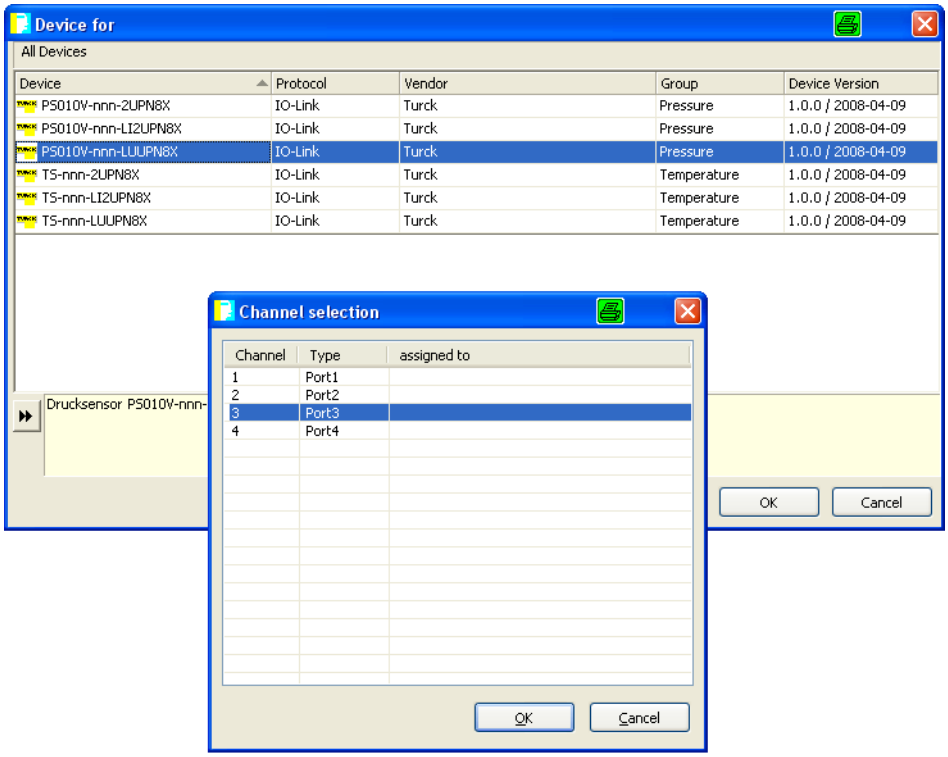
The dialog "CommDTM_PROFIBUS_DPV1" opens automatically. Enter the PROFIBUS-address of the IO-Link master into the CommDTM (in this example: addr. 40).

Figure 32: DP-address for SDPX



Now, the TURCK sensors can be configured for each port of the IO-Link master.

Figure 33: Configuration of the sensors



For the TURCK IO-Link sensors we provide own DTMs, which allow the parameterization of the connected devices as well as the measurement value representation.

Figure 34: Parameter-DTM for a TURCK-sensor

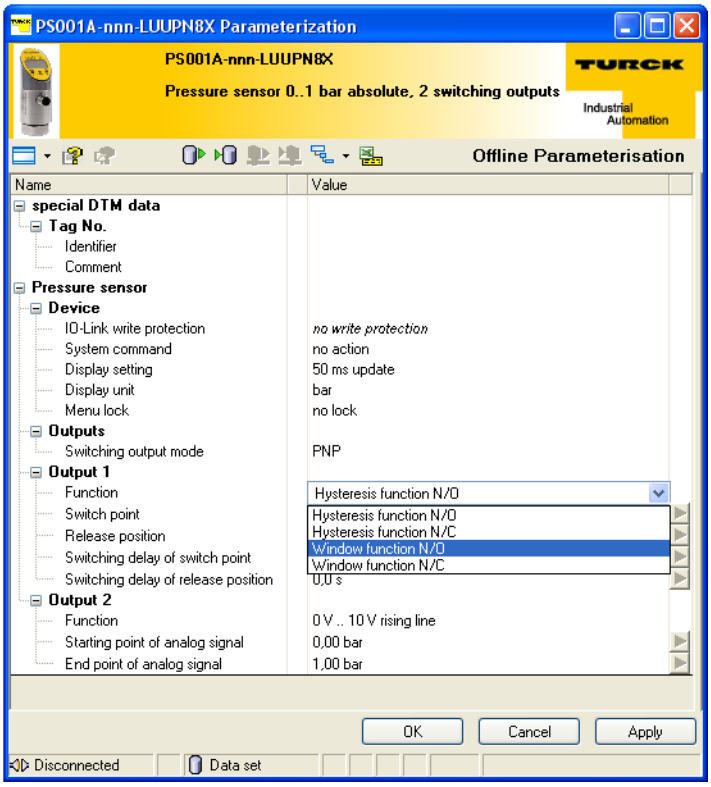
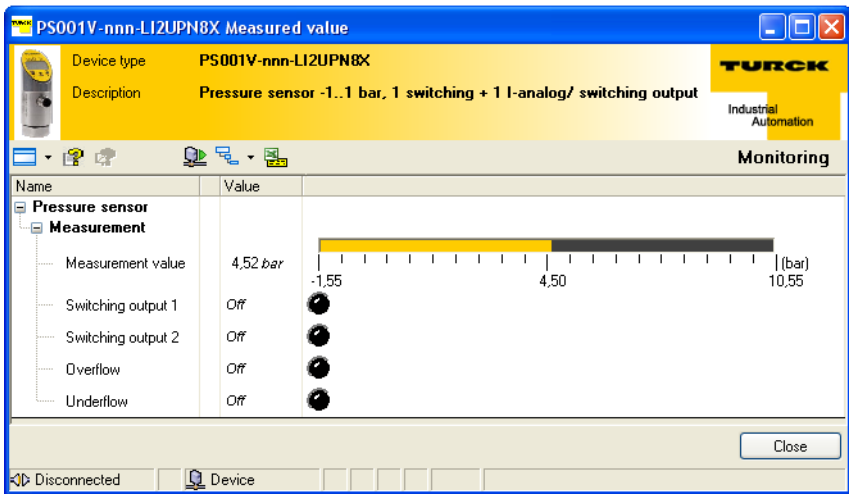


Figure 35: Measurement value-DTM for a TURCK-sensor



Parameterization via DTM

Please observe the following for acyclic parameterization via DTM and C2-master:

Note

If, according to SPS-parameter-settings, the parameter "GSD parameterization" is active, any acyclic parameterization via C2-master will be reset during the next start-up of the C1-master (the PLC).

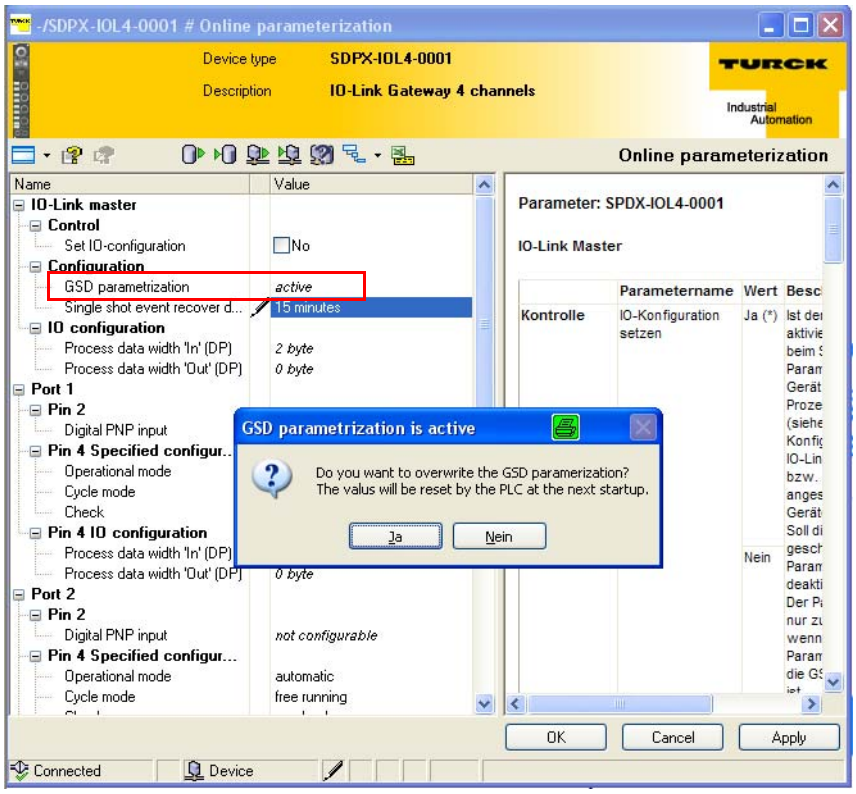
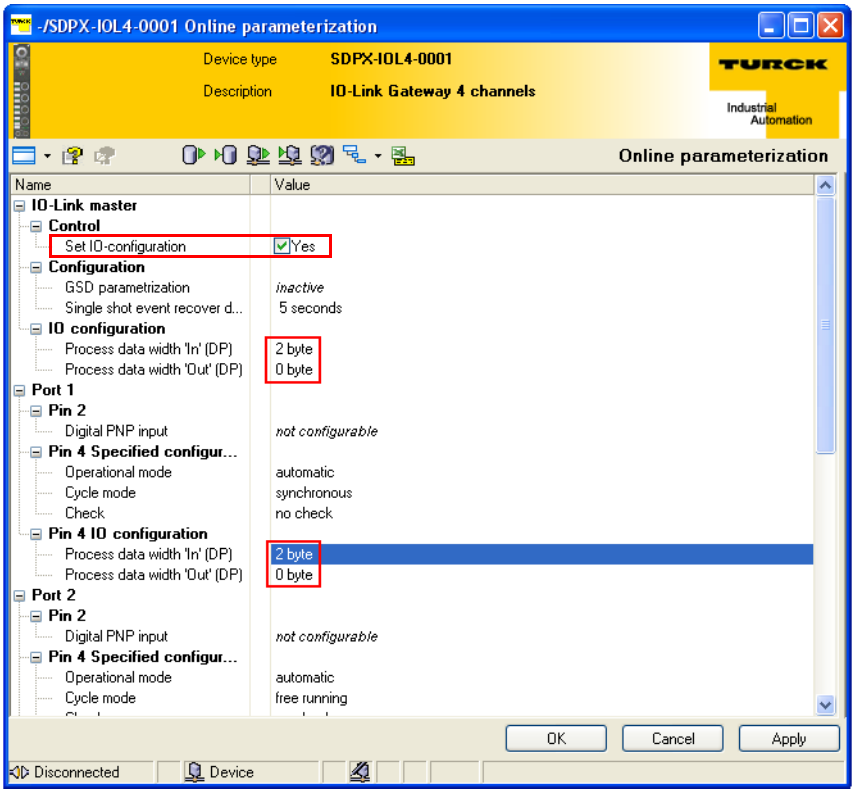


Figure 36: GSD-parameterization active

Operation of the IO-Link master for testing purpose (without PLC)

If, for example for testing purpose, the IO-Link master is operated without PLC which means, only via C2-master, then the IO-Link DTM allows to define the process data widths for the IO-Link master as well as for the connected devices.

Figure 37:
Set IO-configuration



Note

The IO-Link master must not be in cyclic data exchange with a PLC. If necessary, please disconnect the PLC from the fieldbus in order to be able to write the IO-configuration into the master.

6 Guidelines for electrical installation

General Notes 2

General 2
Cable routing 2
– Cable routing inside and outside of cabinets 2
– Cable routing outside buildings 2
Lightning protection 3
Transmission cables 3
– Cable types 3

Potential relationships 4

Electromagnetic compatibility (EMC) 5

Ensuring electromagnetic compatibility 5
Grounding of inactive metal components 5
PE connection 5
– Earth-free operation 5
Shielding of cables 6
Potential compensation 7
Switching inductive loads 7

General Notes

General

Cables should be grouped together, for example: signal cables, data cables, heavy current cables, power supply cables.

Heavy current cables and signal or data cables should always be routed in separate cable ducts or bundles. Signal and data cables must always be routed as close as possible to ground potential surfaces (for example support bars, cabinet sides etc.).

Cable routing

Correct cable routing prevents or suppresses the reciprocal influencing of parallel routed cables.

Cable routing inside and outside of cabinets

To ensure EMC-compatible cable routing, the cables should be grouped as follows:

Group 1:

- shielded bus and data cables
- shielded analog cables
- unshielded cables for DC voltage ≤ 60 V
- unshielded cables for AC voltage ≤ 25 V

Group 2:

- unshielded cables for DC voltage > 60 V and ≤ 400 V
- unshielded cables for AC voltage > 25 V and ≤ 400 V

Group 3:

- unshielded cables for DC and AC voltages > 400 V

The following group combination can be routed only in separate bundles or separate cable ducts (no minimum distance apart):

- **Group 1/group 2**

The group combinations:

- **Group 1/group 3 and group 2/group 3**

must be routed in separate cable ducts with a minimum distance of 10 cm apart. This is equally valid for inside buildings as well as for inside and outside of switchgear cabinets.

Cable routing outside buildings

Outside of buildings, cables should be routed in closed (where possible), cage-type cable ducts made of metal. The cable duct joints must be electrically connected and the cable ducts must be earthed.

Warning

Observe all valid guidelines concerning internal and external lightning protection and grounding specifications when routing cables outside of buildings.

Lightning protection

The cables must be routed in double-grounded metal piping or in reinforced concrete cable ducts.

Signal cables must be protected against overvoltage by varistors or inert-gas filled overvoltage arrestors. Varistors and overvoltage arrestors must be installed at the point where the cables enter the building.

Transmission cables

The bus stations are connected to one another via fieldbus cables, which comply with the RS 485 specifications and with DIN 19 245. Accordingly, the cable must have the following characteristics:

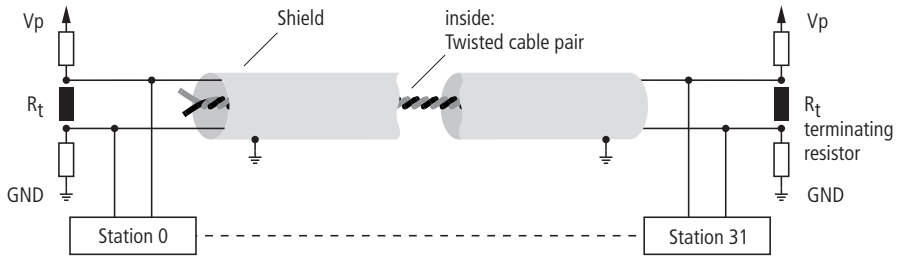
Table 21: Parameter of cable type A

Parameter	Cable A (DIN 19245, part 3)
Characteristic impedance	35 to 165 Ω (3 to 20 MHz)
Capacitance per unit length	< 30 nF/km
Loop resistance	< 110 Ω/km
Wire diameter	> 0.64 mm/ 0.025 inch
Wire cross-section	> 0.34 mm^2 / 0.0005 $inch^2$
Terminating resistor	220 Ω

Attention

The adherence to these parameters becomes more important the higher the baud rate, the more stations there are on the bus and the longer the length of the cable.

Figure 38: Representation of a PROFIBUS-DP cable



Cable types

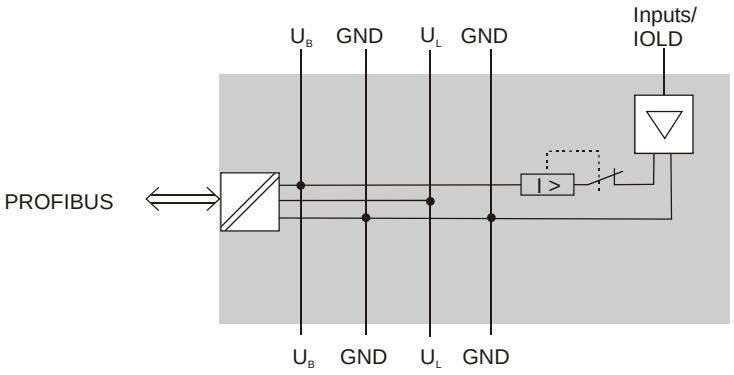
Turck offers a variety of cable types for fieldbus lines as premoulded or bulk cables with different connectors.

The ordering information for the available cable types can be found in the TURCK BL20 catalogs.

Potential relationships

The potential relationship of the IO-Link master with PROFIBUS-DP is characterized as shown in the following figure:

Figure 39: Block diagram of SPDX-IOL4-0001



Electromagnetic compatibility (EMC)

The TURCK IOs comply in full with the requirements pertaining to EMC regulations.

Nevertheless, an EMC plan should be made before installation. Hereby, all potential electro-mechanical sources of interference should be considered such as galvanic, inductive and capacitive couplings as well as radiation couplings.

Ensuring electromagnetic compatibility

The EMC of TURCK I/O modules is guaranteed when the following basic rules are adhered to:

- Correct and large surface grounding of inactive metal components.
- Correct shielding of cables and devices. The grounding lug at the Ethernet-connectors has to be connected as low-impedance as possible to earth.
- Proper cable routing – correct wiring.
- Creation of a standard reference potential and grounding of all electrically operated devices.
- Special EMC measures for special applications.

Grounding of inactive metal components

All inactive metal components (for example: switchgear cabinets, switchgear cabinet doors, supporting bars, mounting plates, tophat rails, etc.) must be connected to one another over a large surface area and with a low impedance (grounding). This guarantees a standardized reference potential area for all control elements and reduces the influence of coupled disturbances.

- In the areas of screw connections, the painted, anodized or isolated metal components must be freed of the isolating layer. Protect the points of contact against rust.
- Connect all free moving groundable components (cabinet doors, separate mounting plates, etc.) by using short bonding straps to large surface areas.
- Avoid the use of aluminum components, as its quick oxidizing properties make it unsuitable for grounding.

Warning

The grounding must never – including cases of error – take on a dangerous touch potential. For this reason, always protect the ground potential with a protective cable.

PE connection

A central connection must be established between ground and PE connection (protective earth).

Earth-free operation

Observe all relevant safety regulations when operating an earth-free system.

Shielding of cables

Shielding is used to prevent interference from voltages and the radiation of interference fields by cables. Therefore, use only shielded cables with shielding braids made from good conducting materials (copper or aluminum) with a minimum degree of coverage of 80 %.

The cable shield should always be connected to both sides of the respective reference potential (if no exception is made, for example, such as high-resistant, symmetrical, analog signal cables). Only then can the cable shield attain the best results possible against electrical and magnetic fields.

A one-sided shield connection merely achieves an isolation against electrical fields.

Attention

When installing, please pay attention to the following...

- the shield should be connected immediately when entering the system,
- the shield connection to the shield rail should be of low impedance,
- the stripped cable-ends are to be kept as short as possible,
- the cable shield is not to be used as a bonding conductor.

If the data cable is connected via a SUB-D connector, the shielding should never be connected via pin 1, but to the mass collar of the plug-in connector.

The insulation of the shielded data-cable should be stripped and connected to the shield rail when the system is not in operation. The connection and securing of the shield should be made using metal shield clamps. The shield clamps must enclose the shielding braid and in so doing create a large surface contact area. The shield rail must have a low impedance (for example, fixing points of 10 to 20 cm apart) and be connected to a reference potential area. The cable shield should not be severed, but routed further within the system (for example, to the switchgear cabinet), right up to the interface connection.

Note

Should it not be possible to ground the shield on both sides due to switching arrangements or device specific reasons, then it is possible to route the second cable shield side to the local reference potential via a capacitor (short connection distances). If necessary, a varistor or resistor can be connected parallel to the capacitor, to prevent disruptive discharges when interference pulses occur.
A further possibility is a double-shielded cable (galvanically separated), whereby the innermost shield is connected on one side and the outermost shield is connected on both sides.

Potential compensation

Potential differences can occur between installation components that are in separate areas and these

- are fed by different supplies,
- have double-sided conductor shields which are grounded on different installation components.

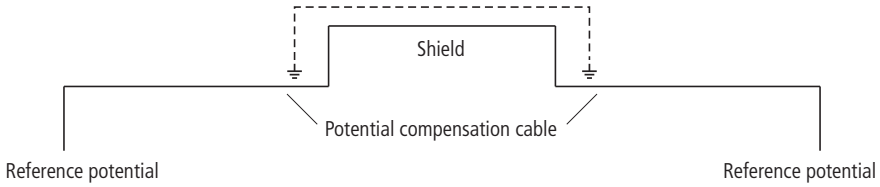
A potential-compensation cable must be routed to the potential compensation.

Warning

Never use the shield as a potential compensation.

Connection A					Connection B
B	3	0	----------	0 3	B
	5	0		0 5	
A	8	0	----------	0 8	A

Figure 40: Potential compensation



A potential compensation cable must have the following characteristics:

- Low impedance. In the case of compensation cables that are routed on both sides, the compensation line impedance must be considerably smaller than that of the shield connection (max. 10 % of shield connection impedance).
- Should the length of the compensation cable be less than 200 m, then its cross-section must be at least 16 mm^2 / 0.025 $inch^2$. If the cable length is greater than 200 m, then a cross-section of at least 25 mm^2 / 0.039 $inch^2$ is required.
- The compensation cable must be made of copper or zinc coated steel.
- The compensation cable must be connected to the protective conductor over a large surface area and must be protected against corrosion.
- Compensation cables and data cables should be routed as close together as possible, meaning the enclosed area should be kept as small as possible

Switching inductive loads

In the case of inductive loads, a protective circuit on the load is recommended.

7 Index

A
acyclic services ... 3-24

C
cable routing ... 6-2
cable types ... 6-3
connection possibilities ... 3-7

D
diagnostic messages ... 3-10
diagnostic telegram ... 3-13
documentation concept ... 0-2
DPM1 ... 1-9
DPM2 ... 1-9

E
earth-free operation ... 6-5
electromagnetic compatibility ... 6-5
EMC ... 6-5
error codes ... 3-14

F
fieldbus connection ... 3-7
function SDPx-IOL4-0001 ... 3-2

G
Gateway Application Instance ... 3-24
GSD-file ... 3-15

I
IO-Link ... 2-1, 2-2
– connector ... 3-7
– FDT/DTM ... 2-4
– fieldbus integration ... 2-4
IO-Link events ... 3-14

L
lightning protection ... 6-3

M
maintenance ... 0-4
Module Application Instance ... 3-24

O
operating ... 0-4

P
parameterization ... 3-19
PE connection ... 6-5
potential compensation ... 6-7
potential relationships ... 6-4
prescribed use ... 0-4
process data transfer ... 2-2
process image ... 3-9
process input data ... 3-9
PROFIBUS-DP
– address setting ... 3-8
– decentralized periphery ... 1-2
– diagnostic functions ... 1-5
– system configuration ... 1-2
– system extension ... 1-3
– system overview ... 1-2
– topology ... 1-3
– transmission rate ... 1-4
PROFIBUS-DPV1 ... 1-9
– functions ... 1-9
protective circuit, inductive loads ... 6-7

S
safe operation ... 0-4
shielding of cables ... 6-6
status displays ... 3-10
storage ... 0-4
symbols ... 0-3

T
technical data ... 3-3
transmission cables ... 6-3
transmission media ... 2-3
transmission speeds ... 2-2
transport, appropriat ... 0-4
trouble-free operation ... 0-4

U
use, prescribed ... 0-4
user data ... 3-24

W
wire length ... 2-2

Index

TURCK

Industrial
Automation

www.turck.com

D301171 1108

Hans Turck GmbH & Co. KG
45472 Mülheim an der Ruhr
Germany
Witzlebenstraße 7
Tel. +49 (0) 208 4952-0
Fax +49 (0) 208 4952-264
E-Mail more@turck.com
Internet www.turck.com